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BRIEFLY TOLD.

THE NEWTON (KAS.) MEETING OF THE KANSAS GAS, WATER AND ELECTRIC LIGHT ASSOCIATION.—It may seem a trifle late in the day to make mention of the success of the fifth annual meeting of the Kansas Gas, Water and Electric Light Association, which was held in Newton, the 11th ult. However, the fault is not ours, for the report of the sessions, for which we are indebted to the Secretary, Mr. S. W. Sterrett, only came to hand last Monday. The meeting was well attended, and the proceedings were competently directed by the President, Mr. W. G. Seabury, of Pittsburg, Kas., whose address was well received. Several new members were elected, and the reports of the Secretary and Treasurer showed that the Association was prospering in all ways. The officers elected were:

President—Jesse Shaw, Topeka, Kas.
First Vice-President—W. T. Soden, Emporia, Kas.
Second Vice-President—C. R. Maunsell, Topeka, Kas.
Third Vice-President—J. D. Nicholson, Newton, Kas.
Secretary and Treasurer—S. W. Sterrett, Kansas City, Kas.
Executive Committee—R. C. Johnston, Lee Riley and J. C. Nicholson.

It was decided to hold the next annual meeting at Topeka, Kas., the 20th of October. It was arranged that a pin emblem of membership should be designed, and it was also proposed that the wisdom of the plan of mutual insurance amongst the members, on account of the high rates charged by the insurance companies, be investigated. The investigation was put in the custody of Mr. C. R. Maunsell. The papers read (several of which will be found in the current issue of the JOURNAL) occupied fully the time that could be spared for their discussion, which in some instances was all too short. When the regular list was finished the members visited the plants of the local Gas and Electric Company, and the shops of the Santa Fe Railway Company. In the evening the members assembled in the auditorium of the Young Men's Christian Association and there listened to a lecture, by Prof. Lucien I. Blake, of the University of Kansas, on "Some Recent Discoveries in Electricity." It is very much to be regretted that the lecture was not reported, for it was in the Professor's very best vein, and truly deserved the special vote of thanks that was passed to him for it. The same may be said of the vote passed to the Messrs. Nicholson, of the local Gas and Electric Company, for their hearty and successful entertainment of the Association on social account. The meeting was in every sense a success, and it was throughout marked with binding evidences of the fraternity that goes with lighting men in their at least annual interchanges of thought respecting progress made in the state of trade.—A.

NOTES.—

THE death of Levi Stevens occurred at New Castle, Pa., the morning of the 4th inst. Deceased, who was in his 79th year, gained some notoriety in the gas business through his exploitation of a water gas process devised by himself, and commercially known under the name of its inventor. The process was installed in the State prison gas works at Trenton, N. J., where it met with a fair measure of success, being under his direct supervision as Superintendent for a term of years, in fact until the present owners of the South Jersey Gas, Electric and

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Traction Company made the State authorities a rate for gas that put their "home" plant out of commission. The funeral services were held in the home of his son, Levi Stevens, Jr., Trenton, the morning of the 6th inst.

"F. J. S." INCLOSES the following, from Merced, Cal.: "The City Trustees of Merced have passed preliminary ordinances relating to the establishment of water and light plants to be operated on municipal account, which action was based on a petition signed by well over 200 residents. The three Trustees who were elected last April are in favor of municipal ownership of about everthing that can be owned here; in fact, it was upon that issue that they were elected. Nor can it be denied that the issue finds favor with many of our residents of the tax paying class. Why this feeling should exist is a puzzle to me, for our city is supplied with water, gas and electric lights by a corporation whose plants are complete, and whose service in general is of the most excellent sort. In fact I have no hesitancy in saying that it would be difficult to improve on the service; cheap, effective and sustained it undoubtedly is. So one is at a loss to find reason for the underlying spirit that prevails for a change from private to public ownership, unless it be that those who are not conversant with the operation of such undertakings are of the belief that their management thereof would exceed in results the management of those qualified by experience to direct them. This feeling is spreading rapidly in our State, and it would look the part of wisdom for those interested in lighting plants to urge the formation of a State commission that, as has been amply shown in the Massachusetts illustration, would shield the interest of the company and consumer alike."

THE Otsego Light, Heat and Power Company, of Oneonta, N. Y.. to manufacture, distribute and sell gas and electricity in Oneonta, Laurens, Cooperstown, Richfield Springs, Mohawk and Herkimer, and the towns of Hartwick, Otsego, Milford, Exeter, Warren and German Flats, all in Otsego and Herkimer counties, N. Y., has been incorporated by Messrs. Edward C. White and H. T. Jennings, of Mount Vernon, N. Y., and Chas. D. Peck, of New York city. The purposes of the corporation, which are just now of the mysterious sort, will likely be found in its desire to merge certain electric lighting interests operated at present on independent lines in some of the places named.

AN odd suit is reported as begun in Indianapolis, Ind., by the United States Casualty Company against the Indianapolis Gas Company for $20,000. Complainant alleges that such sum is due on a policy of insurance, under which it entered into a contract with the Gas Company, whereby it agreed, on the payment of an annual premium of $5,000, to insure the Company against common law and statutory liabilities because of accidents to employees. This was to be the amount of the premium as long as the pay roll of the Gas Company did not exceed $100,000 a year, an increase or decrease to affect the premium *pro rata*. The Company alleges that since the date of the insurance in 1898 the pay roll of the Gas Company has been almost $200,000. It is suing for an amount equal to an additional premium of $5,000 for each year of the insurance.

THE proprietors of the Minneapolis (Minn.) Gas Light Company have purchased a plot of land in the block lying between Chestnut and Linden, Aldrich and Lyndale avenues, whereon it is proposed to construct a large storage holder.

A CORRESPONDENT in Denver, Col., forwards the following under date of the 8th inst.: "The time for the deposit of the stock and bonds of the Denver Gas and Electric Company, under the plan of reorganization outlined at the time the Company went into the hands of a receiver, which was noted in the JOURNAL, has been extended to the 15th inst., at which time it is presumed the plan of reorganization will be perfected. According to reports recently received from New York about two-thirds of the stock and bonds have been deposited under the agreement with the reorganization committee. This fact assures the committee authority to proceed with its plans. Deposits of securities of the Company may be accepted by the committee after December 15, at their discretion. The Trust Company of America, of New York, the Michigan Trust Company, of Grand Rapids, and the Ohio Trust Company, of Columbus, are the depositories."

THE South Jersey Gas, Electric and Traction Company has purchased the plant and franchises of the Bristol (Pa.) Electric Company.

THE story that American capital, linked with the francs of some Frenchmen, is about to control the gas supply of Paris, France, is again in evidence. It may be taken for granted, however, that such supply will always be controlled by French capital.

On the Use of Gas for Warming Inclosed Space.

By THOMAS FLETCHER, F.C.S., Warrington, England.

I have been asked to reply to an article[1] in the AMERICAN GAS LIGHT JOURNAL, by Dr. W. H. Birchmore, on the above subject. It would be a waste of time and space to traverse and disprove the whole of his curious statements and "assumed" figures; the correction of some of the simple and most glaring errors will be sufficient. It must, of course, be borne in mind that the system of heating used in this country is totally different to that in America, and that the close, dry heat and absence of ventilation there would not be accepted here; and the criticism refers, in its fullest sense, only to the English methods, although as regards actual facts and practice in America Dr. Birchmore's errors are too glaring to be allowed to pass.

The figures given as a case in practice refer to a room 16 by 12 by 8 feet, 1,536 cubic feet air capacity. According to the English hospital standard 500 cubic feet space is required for each adult; the room would, therefore, be large enough to be permanently occupied by 3 persons. The smallest space allowed in English common lodging houses is 240 cubic feet for each, and at this rate the room would accommodate say seven persons for sleeping only, to be thoroughly ventilated during the day. The smallest amount of fresh air considered necessary for respiration in English and Continental hospital practice is 500 cubic feet per hour for each adult—*i. e.*, 1,500 cubic feet for the three persons; yet Dr. Birchmore "assumes" that 100 cubic feet only will be required. Why he assumes that the recognized healthy standard is 15 times too large he does not state. With a ventilation of 212 cubic feet per hour per head, M. Peclet found a slight odor in a public school of 180 children of the age of 7 or 8 years. (See Box "On Heat," page 243). For cleanly and healthy persons the accepted minimum is 250 cubic feet, for respiration, etc., and 60 cubic feet for lighting. These are the quantities proved to be necessary by the greatest authorities as standards; the fact that Dr. Birchmore "assumes" they are all wrong does not carry much weight, and as his figures are based on this standard, evolved from his imagination, they are of little use.

With regard to heating the air of the room, it may be accepted that 1 cubic foot will heat 825 cubic feet of air 42.5° as stated. This, of course, varies greatly with the composition and heating power of the gas, which, in the United Kingdom, will vary 30 per cent. more; but that this air when warmed will retain its heat is a state of things existing in Dr. Birchmore's imagination only. The loss of heat by walls and windows has never, in any experiments I have made, or in the reports of any trustworthy authorities, been less than 75 per cent., and varies from this to 87½ per cent., independently of ventilation. The most charming point of all is that he "assumes" a renewal of 125 cubic feet per hour in a room 1,536 cubic feet capacity; *i. e.*, less than once every 12 hours! Now as all the greatest authorities state that 500 cubic feet of fresh air per hour will be necessary for each healthy adult, and that the air in the room, if it is to be kept sweet, must be entirely renewed at least three times each hour, and more frequently if possible in case of sickness, it becomes rather interesting to know the result of the proposed reduction. It would probably be difficult to match, even in the foulest and filthiest underground Chinese dens; certainly the most crowded and dirtiest English common lodginghouse would be a paradise compared to it.

I will leave out the question of the comfort and consequent urgent demand in this country for radiant heat in preference to warmed air, flueless stoves, and other sources of convected heat, which, although very much cheaper than radiant heat, is greatly disliked in this country. It is possible under the best conditions to reduce the loss of heat by a flue to 28 per cent., but such economy as this will be very rare, and it may be taken, in average English and Continental practice, that the flue loss where radiant heat is obtained in any large proportion will be quite 50 per cent. Taking this, the "assumed" 100 cubic feet for ventilation being at least 15 times as great, and the actual loss by walls and windows being at least 75 per cent. of the whole, Dr. Birchmore's "assumed" figures require a *little* correction. It would appear that he has actually obtained the results stated in practice, and that by some wonderful method he has done away with loss of heat through walls, etc., opening doors and the many other ways in which heat disappears, and this opens up a new vista, and a source of heat hitherto neglected which should render all fires and stoves unnecessary. It has been found that 284 units of heat are generated per head per hour, and this heat must be dissipated to keep the body in health. It would occupy too great a space to go through the calculations and trace the

1. *Ante*, p. 587, Oct. 27, 1902.

authorities, but those interested will be able to do so by reference to "Box on Heat," page 243. As the average heating power of our local gas is given as 720 units per cubic foot, it will only be necessary for three persons to remain in the room to make it too hot for comfort, which being the case, as proved (?) by Dr. Birchmore, no other heating apparatus will be required, and his wonderful stove, which will probably[1] be brought out with a great flourish and offered for sale, is proved by his own figures to be totally unnecessary, every person being his own stove and warming apparatus, with a decided margin of power to spare. All this great discoverer needs now is to invent a method of utilizing this spare heat for lighting, and we should then be both warmed and lighted by our own natural forces. Evidently the resources of nature are limitless, and the dreams of the most sanguine fade into insignificance before this, the greatest discovery the world has known. If he will perfect this I shall only be too pleased to negotiate with him for the English patent rights.

The Economy of Reconstructing Central Stations to Modern Methods.

[A paper read by MR. C. R. MAUNSELL, of Topeka, Kas., at the last meeting of the Kansas Gas, Water and Electric Light Association.]

The majority of central stations in Kansas, and in other States as well, have not paid the returns on the investments that were expected, and in a great many cases the reason has been that the machinery installed was not suited to the conditions of operation, and the lack of knowledge of the proper business methods.

The usual scheme has been about this: The promoter of the plant first gets the idea that an electric light plant would pay well in his town; he talks the matter over with his associates, and they all agree it would; not one of them, however, knows anything about the business.

The next move is to find out what the cost would be, and some supply house or manufacturer is asked to pay them a visit. The best salesman is sent; he knows very little about the operation of a plant, but can sell goods. His first effort is to find who knows what is wanted and who is to buy the equipment. When this is ascertained, he generally finds they want information more than anything else, and, being a good salesman, he gives them all he has; in other words, he lays out the plant, except the boilers and engines, as everyone connected with the scheme knows just what is here required. In this part the most expert advice is necessary, as right here lies the success or failure in the lighting or power business.

Having made a good guess at the start of a plant, let us see the results. The conditions are as follows, taking one small plant for an example:

The town has 5,000 to 7,000 population, and the city fathers have agreed to take 15 or 20 arc lamps at a rate paid by some other town, with water power to operate the machinery or other great difference in the cost of fuel.

The number of incandescent lights for commercial use have been decided as 1,000, all within an area of 2,500 feet from the site of the station; the residence supply has not been taken into account, as the salesman said this could be taken care of after the plant was started. No power load was considered as being a possible source of revenue, therefore the plant would only be in operation from 6 to 12 hours at the most. Anyone wanting a day service had to do without it.

We are now ready to build; the site is bought, a building is planned and built, and we are ready for the machinery. The mechanical man of the scheme selects one boiler of 100 horse power capacity, one pump for feed water, and, maybe, a heater. The engine is his next care. He knows nothing of steam as measured in pounds, so any old engine that is well recommended by the salesman will do.

It may be that coal costs $1.50 to $4 per ton, but the engine is the same in either case, for it must be a cheap engine, as capital is limited. The electrical salesman has found this out also, so he sells an alternating generator of high speed and an arc machine of as many lights capacity as he can get money for; no wattmeters are wanted, so the consumers can have all the light they can get while the plant runs.

The consumers have agreed to wire for the incandescent lights, so that expense is out of the way; but arc lamps may be wanted in stores, as every arc machine is sold with the full number of lamps included, the expense for wiring will be a small cost.

In short, the plant is completed and in operation; the engine man, boiler man and electrical man have their money and are gone. The mechanical man is left in charge; the plant apparently runs all right, and all are pleased with the new enterprise except the man with his money invested. He is anxious to know the results the first year, which soon passes, and he is called on for about 50 per cent. more than he wanted to put in the plant, but he must go on or lose all, so he puts up or gets his friends to. But all this happened 10 years or so ago and is forgiven, as there was no one who knew much about the business at that time.

Since these plants were installed we have all learned a few things *not to do*, and only the few have learned what to do to make plants a success; even the manufacturer employs an engineer to lay out plants complete, to his advantage and sometimes to the purchaser's.

What would you do if you had a lawsuit or a case of sickness? Would you ask a few questions of your lawyer or doctor friends, and then plead your own case in court or prescribe for the patient? If so, Lord help the sick one! Why should most men think they are competent to lay out an electric light plant when they know as little about the profession as they do of the other cases cited? Why not pay someone for the knowledge that he has at your disposal; it will save you his charge for services many times over.

In the plant cited above his first care would be the site for the station, then the electric machinery, which would serve all classes of service from one set of generators. Next, can steam heating be made to pay? This brings up the power supply, which means 24 hours' service to all, with increase of revenue from lighting customers, to say nothing of winds and fan business.

He has decided heating can be made a success, and his boilers and engine must be selected for this service. Three new 75-horse power boilers, suited for the water to be obtained and set from what experience has proven as the only proper way (in good brickwork on a foundation supplied with good draft); a pump with an injector for emergencies, with feed water heated to the boiling point.

The coal cost is $4 per ton, so the engine that is guaranteed to operate on the least pounds of steam per horse power hour is purchased; in this case, two 75-horse power Corliss. As back pressure is carried in winter, the horse power is rather high, but one engine will do the load in summer and mild weather, leaving you a reserve engine, which is a guarantee to the consumer that you mean to take care of him at all times, and he relies on you and gives you his power and heating business also, which enables you to make the necessary investments for such a plant, which is a credit to the town.

The next step is the generating machines, two 60-kw. direct current at 250 volts is the selection, belted direct, and each with a wattmeter to give the amount of current made, so you will know how to sell it at different times of the day and night, by meter only, except to the city street lights, which are controlled from the switchboards in the station. The consumer will buy his arc lamps and pay for the wiring, if he can get current at living rates, should you put the proposition to him in the right way; the engineer will tell you how to do this.

All this seems to be getting away from the caption of this paper, but I hope the comparisons made will suggest some changes in plants that are now in operation, feeling quite sure that a change from the first plant outlined to the last one would convince anyone of the economy in operation and the possible revenue to be obtained, in towns of 5,000 to 7,000 population, when it is considered that the last plant is earning a revenue every hour of the day and night, therefore, much more useful to the owners and public.

Taking an estimate of cost for each plant with the revenues and expenses, the following figures are given. Juggle them for yourselves:

Plant No. 1.

Cost	$15,000
Revenue, per annum	6,000
Expenses	4,800
Net	$1,200

8 per cent. net on investment.

Plant No. 2.

Cost	$28,000
Revenue from lighting	9,000
Revenue from power, fans and day lighting	3,500
Revenue from steam heating	5,000
	$17,500
Expenses	11,000
Net	$6,500

23 per cent. net on investment.

[1] Dr. Birchmore is in no way commercially interested in the development and sale of gas stoves for cooking or heating purposes, other than that he would like to see the sale thereof very much multiplied.—Eds. A. G. L. J.

Recent Developments in the Economy and Variety of Fuel.

[A paper prepared by PROF. E. H. S. BAILEY for the last meeting of the Kansas Gas, Water and Electric Light Association.]

The recent anthracite coal strike has led to valuable investigations in the direction of greater economy of fuel. This economy has been, first, by producing greater saving in combustion; second, by substitution of other fuels. Fuels in general are valuable as they contain large quantities of carbon or of hydrocarbons. Carbon itself will give off 8,080 heat units per pound of fuel, while hydrogen gives off for the same quantity, 34,462 heat units. The value of the fuel, however, depends upon a great many conditions besides the quantity of carbon and hydrogen that the fuel contains. The simpler fuels, such as wood, peat (which contains much water) and charcoal, have been used from the earliest time. In later times more concentrated fuels, such as different varieties of coal, and later petroleum and natural gas, have been utilized as fuels.

Comparisons of Coals.

Cannel	....	2.77	66.35	30.88
Bituminous	6.75	11.10	36.40	45.75
Semi bituminous	....	10.34	15.13	74.53
Anthracite	....	7.28	2.52	90.20
Semi-anthracite	....	2.20	8.96	88.84
Lignite	8.24	3.45	49.96	38.31

Composition of Kansas Coals.—Average.

Cherokee	1.94	36.77	52.45	8.84
Ft. Scott	2.94	41.76	47.55	7.75
Leavenworth County	2.69	39.21	47.41	10.69
Linn County	2.07	39.42	46.89	11.62
Osage County	6.76	41.59	40.86	10.76
Franklin County	7.55	44.40	37.68	10.37

The composition of coals, as shown by the tables, varies considerably, and we have all grades, from the anthracite coal, often giving only 3 per cent. of volatile matter, to the bituminous coal, yielding 50 per cent. of volatile matter. The relative composition of the different kinds of coal will be noticed in the table, and also the composition of the various kinds in the Kansas coal. It will be seen that the volatile matter in the Kansas coals increases as we go from the southeastern portion of the State toward the northwestern. The fixed carbon, on the other hand, decreases in the same proportion. The variety of fuel to be used in a certain case depends much upon circumstances. The question is whether we wish to have a long flame distributed over a larger surface, or concentrated heat at one point.

The economy of fuel has been a subject of study and investigation for many years. As long ago as 1797, Count Rumford, the ingenious Yankee, who found favor in the sight of the King of Bavaria, wrote in one of his books: "I never view from a distance as I come into town this black cloud which hangs over London without wishing to compute the immense number of chaldrons of coal of which it is composed; for could this be ascertained I am persuaded that so striking a fact would awaken the curiosity and excite the astonishment of all ranks of the inhabitants and perhaps turn their minds to an object of economy to which they have hitherto paid but little attention."

We know that, with ordinary boilers and engines, there is a loss of from 80 to 90 per cent. of the heating value of the fuel, and that a very large portion of this loss is due to the gases that are carried off in the stack. One of the improvements, then, that has been found to lead to great economy in the last few years, is the utilization of the waste heat of a furnace in the stack, by passing the gases over pipes through which the feed water is delivered to the boiler. In the arrangement of these pipes it is of the utmost importance that they should be placed in the right position relative to the furnace, that they should not be so abundant or so close together as to interfere with the draft, that there should be no permanent deposit of carbon upon the pipes. This deposit would interfere with the heating of the water and would greatly check the draft of the furnace. To avoid this some manufacturers have introduced a mechanical arrangement for scraping the pipes free from soot. If forced draft is used, it is important to consider whether we can afford to use more power for furnishing a sufficient quantity of air to the furnace.

In the burning of oil, which will be discussed later, and in the burning of natural gas, a great deal of thought has been expended upon the method for producing complete combustion. The laws of many of our cities require practically smokeless combustion in the chimneys from large manufactories. This has done much to help along the matter of complete combustion of the fuel, and so in a sense it has tended toward economy of fuel. Very much has been done also to adapt the furnace, the grate bars, the ash pit, and the flues to the particular variety of coal which it is proposed to use.

The second result brought about by the striving for economy in fuels is a development of a great variety of new fuels or of fuels from new localities.

The anthracite fields of the United States, it is said, will not last more than about 75 years. We have also in this country a small deposit in North Carolina and in New Mexico. There is a sort of an anthracite in the southern part of Wales. In Prussia is a semi-anthracite, in Silesia and in Southern Russia also, but the largest field of anthracite that we have to draw from in the future is in China. As far as this country is concerned then, if we take a broad view of the subject, something must soon be done to limit the production of anthracite, or this fuel will be out of the market. The recent strike has stimulated development in some of the Western fields, particularly in New Mexico and Colorado. There is no doubt about the desirability of anthracite as a fuel for many purposes, and there is quite a variety even in Pennsylvania anthracites. We have, first, the hard Lehigh coal, which contains only about 1 per cent. of volatile matter; then the Lackawanna and Lykens Valley coals, which are so desirable for domestic use, and contain 5 or 6 per cent. of volatile and combustible matter; and finally the still softer coals known as the Bernice coals of Sullivan county, which contain as much as 10 per cent. of volatile and combustible matter. As we increase the quantity of combustible and volatile matter, we come to another class of coals known as semi-anthracites, of which the Arkansas coals are a type.

At the outset it should be said that it is always a grave question whether *cheap* coals are economical. Suppose we have a difference even of $2 per ton in the cost of coal. This may be more than balanced by various items, such as the increased cost of labor to handle larger quantities of the poor fuel; greater cost of moving the ashes; increased action on the grate bars from an impure fuel containing large quantities of sulphur; stoppage of the flues by dirt and soot from the low grade of coal, and, if the mechanical stocker is used, more power will be required to handle larger quantities of fuel and there will be a greater liability of derangement of the machinery.

The soft coals of this country will, of course, last for a long time, but there are many situations in which soft coal is not convenient as a fuel. It may be interesting to notice that, according to a recent author, the heating value of anthracite varies from 14,600 to 14,800 British thermal units per pound; that of semi-anthracite from 14,700 to 15,500; that of Western bituminous from 13,500 to 14,800.

It is interesting to notice the great variety of substitutes for coal that are suggested. One man comes forward with some porous substance saturated with kerosene oil and claims a perfect fuel, another has invented a new burner that will utilize ordinary kerosene as fuel in a furnance, first volatilizing it as is the custom in the use of gasoline.

The manufacture of briquettes from coal slack has been seriously suggested. It is a fact that this has become an important industry in Germany. The screenings of coal are mixed with a mineral pitch which is also combustible and only costs 50 cents per ton, and the blocks are compressed by hydraulic power. In 1901 the total output of briquettes in Germany was 1,643,416 tons.

The recent discovery of large quantities of petroleum in Texas and elsewhere has led to a very full investigation upon its value as fuel. From an article by Wm. Kent is taken the following table of pounds of water evaporated per pound of fuel by different combustibles:

Petroleum (from 18° to 40°)	16 pounds
Pittsburg lump	10 "
Anthracite	9.8 "
Indian block	9.5 "
Pocahontas lump, Virginia	10.5 "
Carbon Hill, Washington	7.6 "

It will be seen then that per pound petroleum has great fuel value. Experiments of this kind have led to the extensive use of petroleum with or without other fuels as a steam producer under boilers. One example is sufficient. At the Western sugar refinery, San Francisco, 700 barrels of Coalinga petroleum are burned per day. When coal was used 26 firemen were employed. Now 12 are needed. This oil gives an average evaporation of 13.9 pounds, while the average of the coals formerly used gave 7.88 pounds, so it is estimated that the saving in this refinery is $46,000 per annum by the use of oil in place of coal.

There is without doubt a tendency of the times to substitute other and better fuels for soft coal. This tendency is apparent not only on a large

scale in manufactories and for city service, but also on a small scale for domestic use. In those localities where the people have become accustomed to natural gas, when that gas gives out, as it is beginning to do in some localities in Ohio, Indiana and Pennsylvania, it will be difficult for the people to go back to the wasteful and inconvenient fuel, soft coal; so that there will be a demand for some kind of fuel gas. Fuel gas can be made from very cheap material, as for instance sawdust, and even from the refuse from cities. It can be made from coal slack and cheap coal, and, finally, from crude petroleum. We have then all these materials at hand, which can be used for the preparation of fuel gas, which can be delivered to customers at a price much below that which it is necessary to charge for the artificial illuminating gas. It is evident that this industry of supplying fuel gas will begin on a small scale, just as steam heating for residence districts was begun on a small scale. On account of the immense advantage that this fuel has over wood, coal, coke, or any artificial combustibles, even at a somewhat increased price per year, a fuel gas would find ready sale.

If this gas is burned, as most fuels are, with a sufficient draft or chimney, we should have no serious inconvenience with impurities contained, but it might be possible to purify the gas sufficiently for domestic use so that the products of combustion would not be injurious or disagreeable.

It is true that an attempt to use the gas pipes laid down in our cities for conveying the fuel gas instead of the illuminating gas would not be satisfactory, as they have not sufficient capacity, but with the increased use of the Welsbach burner for giving light, and of electric lights, it is evident that we have come to the point where there is practically little use for a gas that contains illuminating materials. So with a larger supply of pipes the same company could supply a gas that could, if necessary, be used for illuminating purposes with the Welsbach burners, and at the same time furnish fuel gas.

Why the People Distrust Gas, Water and Electric Companies.

[A paper read by MR. S. W. STERRETT, of Kansas City, Kas., at the last meeting of the Kansas Gas, Water and Electric Light Association.]

That the people distrust public corporations such as we represent is a self-evident proposition. The public and the corporations are about equally to blame for this condition of things. The public is to blame for being ignorant of the principles which govern a gas, water or electric service. When a company goes into a new territory, as our company has done in the past few years, it is astonishing how very ignorant the people are on the subject of gas. Apparently sensible people—on most subjects—have been known to ask, "Is gas dangerous? Is it more dangerous than gasoline? Will it explode?" or, "I'm afraid of gas." Once, when our man was showing a stove, the lady asked him to put it out and let her see it run on the floor. The same person who says "I'm afraid of gas" will fill a gasoline stove by lamp light. In this day, when so many daily papers and periodicals are printing information on these subjects in almost every issue, it seems strange that people do not understand. It is not strange, however, that the people distrust these corporations when they distrust the public officers who make the ordinances controlling them. They are continually on the lookout for unfair treatment, and in their ignorance they look in the wrong place, or imagine something is wrong when, if they understood the facts, they could discover the real trouble and remedy it.

When a person decides to try gas he first asks his neighbor what he knows about gas. If the friend or neighbor is a fair minded person and is using gas, he may say that it is very nice and convenient to use and not very expensive; if, however, the friend has never used gas, or, perhaps, has used it and had an unsatisfactory experience—and is of a gossipy disposition—he knows all about the gas company, and at once tells the prospective consumer that "They are a set of robbers." Primed with a lot of this kind of information the timid applicant finally gets into the gas office and states that he "Would like to get the gas turned on, if you don't charge too much." The clerk asks the usual number of questions about the name, address, what he wants to use gas for, is the gas into the house, has he a stove, etc. Then—if he is a stranger—what reference he can give. Each question is pumped from him like a cross examination, the applicants getting more and more disgusted as they proceed. Perhaps he will say that he is just as honest as the gas company, which does not mean very much, in view of the opinion he has gathered from the neighbors. By this time the applicant has been stirred up enough to get over his first fright—finding the awful gas company is represented sometimes by a very meek looking clerk—he begins a few questions on his own account. "How much do you charge for gas?" He is told the price, and again asks, "I mean, how much is it a month?" This one is not so easy to answer, but the clerk uses his best judgment and answers that it depends upon the size of your family. "There are only five of us, myself, wife and three children; the oldest is thirteen," he interrupts. Also, upon the number of meals per day and the length of time the gas is burning, adds the clerk.

"Well, how much is it for a family of five?" The clerk probably says, "I don't know, families are so different. We have some who have bills from 10 cents to $7 or $8 per month. It all depends upon the way you handle it yourself."

"I suppose it's 10 cents the first month and then you raise it each month until it gets $8, smiling confidently. Oh, I've heard about how you run up the bills." The fact that the clerk can give him no definite amount for his monthly bill tends to substantiate the testimony given by his neighbors, that the company makes no definite arrangement about the price, but makes the bill according as it "needs the money" on the first of the month.

After some more sparring he signs the contract without reading it, adding verbally that if you run the bill up on him he'll have it "took" out and use gasoline or some other dangerous fuel. He goes home and tells the family that he has found out all they were willing to tell. That they would not know how much gas they were to use, until the gas company should come around the first of the month and tell them. So they decide to use as little gas as possible the first month, just to "See what it will cost;" they would use baker's bread for awhile at least, and not have warm biscuits for breakfast until next month. As for a bath, it being warm weather, they could go to the river, if they should need one. The family are up bright and early on the first of the month to see whether they have been robbed. The collector brings the bill—30 cents—and it is paid without an objection. Joy is great in the household, for to-morrow they can have biscuit for breakfast, for they decide that if that is all gas costs it is cheap enough, and they will hereafter use all they want. The second month's bill is usually the hardest to collect, for they argue that if they are extravagant and use as much as 50 cents worth it would be cheaper than coal. But when the bill comes in, $2.90, the family go into mourning. These matters finally adjust themselves. If the family is poor it uses as littie as possible or stops altogether, if rich it uses still more and kicks the harder.

It is a strange fact that most people will not investigate pertinent questions; no matter whether poor and ignorant or wealthy and well informed generally. I have had gentlemen come in and say, "Something is wrong with my meter; it is running too fast."

"What makes you think so?" I ask.

"Because, my bill is a great deal larger than last month, and we have not used anything like as much gas."

I then ask, "How do you measure the gas you use?"

"Well, you know yourself that I couldn't use that much gas with just 6 in the family. It's impossible." I then tell him that almost anything is possible; that his bill might even be wrong; or that it might not be high enough. They usually ask to have a new meter put in; that this one is no good; in fact was an old one when it was first set. He is positive that it is running too fast. I explain how it is next to impossible for a meter to run too fast. I convince him that I am right, but he is not satisfied with the bill. I suggest that perhaps his servant wastes the gas, but he replies that his wife takes care of that, and that she is the most economical woman alive, which closes this line of argument. This man has no real information about his gas account. He has been handed the bill which seems large, and on questioning his wife about it she says the meter must be wrong, so down he goes to the gas office and wastes an hour when he should be attending to business. They are often satisfied with having a man inspect the meter and pipes, but mostly they come in mad and say, "There's a leak in my meter, I can smell it in the cellar, and my bill is twice as big as ever before." He brings the bills along to show. If our man goes out and finds a leak near the meter, the consumer wants his bill "cut in two" at once. Perhaps the leak was on the service side of the meter, or too small to register, as is mostly the case. When he is told the result of the investigation, he is very much disappointed. Why? Because he has been supposing the company was robbing him, and that now he had caught it, never thinking how careless were his own folks in using the gas. "Well, I know there is something wrong with that meter, for I can hear it 'click' when I go down the cellar. Besides, I have heard that the company pumps air into the pipes." You will find that almost all the charges are "hearsay;" few people ever catch the company doing wrong, but they hear of it at all times; so

does the company. You can show him the fallacy of this charge, and he says, "I suppose I may as well pay first as last; there is no way to beat the gas company."

I ask another man, "Did you read your meter to see if the bill is correct?"

"Oh, I don't know how to read the meter; and besides, I have no time to bother with it. All I want is fair treatment."

"Yet you say we are all robbers, and still you never check your bill to see if it is correct. I don't believe you allow your clerks to receive goods without checking them off.

"Well, that's different. You people are supposed to look after the meters, and you can just make the bill to suit yourselves." You don't mean to say that I'm a robber, or that Mr. ——— is?" "Oh, I don't mean you folks. I mean these corporations. They fix the whole thing and you fellows have just to do what they say or lose your job." All I can do is to thank him for the compliment while he pays the bill.

Then you all know about the man whose bill is larger than his neighbor's, despite the fact that the said neighbor has as many children who are just as hungry as his; and the man who takes his vacation, locking up his house, to return and have a gas bill, "Just the same." Our people say the gas bill is like death and taxes.

Thus far we have proceeded on the theory that the company and employees are all right and the people all wrong. How about the long set of rules and red tape through which a not overamiable or discreet clerk likes to drag an applicant. To say nothing of the sometimes impudent, incompetent employee, who can do so much in a few moments toward sowing the seed of discontent and distrust among those he has to deal with. What about the meter which was underread last month? I believe that careless or negligent meter reading does more toward causing dissatisfaction than any one thing, unless perhaps a disagreeable employee. Take, for instance, a fairly good customer, a reasonable man, who has thought for some time that he was paying too much for gas, but said nothing. Then let a careless meter man underread his meter one month. The customer feels that the company has had a change of heart and is going to treat him fairly, and he is much pleased. But what happens next month when his meter is read, and the correct reading is taken? The bill is the highest ever presented. "Mr. Consumer" has now very decided opinions, comes to the office and demands justice. A man is sent to verify the reading and reports it correct. Now, how are you going to show this man? To be sure it was an error, and anyone may err, but we have no positive evidence except that he has only paid what the meter shows he has used. This is legal evidence and according to contract, but we are in danger of losing a good customer through error. If the error is the result of criminal negligence on the part of the meter reader, as I believe has occurred sometimes with us, it would pay the company to devote some time and expense to clearing up all doubtful cases. One case I know of was where a meter reader spent part of his time in some friendly shade, estimating the amount of gas used by the people in a certain district. Our company divides the territory into 12 districts, and as we do not have work for so many men all the time we employ extra men for a day or two at meter reading time in order to have the work done quickly. The fact of being obliged to frequently send a new man often causes dissatisfaction. The consumers say the company does this for some covert reason, or that the new man is incompetent and makes the bills higher. They seem to like a familiar face. They do not know how the meter operates, and any explanation is less than satisfactory.

Again we have an increase in the size of the gas bills, beginning with the fall months and on until the shortest and coldest days. It taxes the ingenuity of the gas man to answer the questions put to him as soon as the days begin to get short or cold. We are asked: "Why is my bill larger this month? I have no more to eat, nor do I burn any more lights." While the highwayman lurks about the dark street corner to rob the poor man on his way home, the gas man is supposed by many to be sitting in his comfortable office devising all kinds of schemes to make the bills larger. It is not hard to tell how the lights are in use longer, in some cases twice as long, but why it should take more gas to cook a steak or boil coffee at one time in the year is more than the average person can believe. Yet, I have succeeded in convincing some rather fair minded men that it takes more heat to boil ice water in the winter than warm water in the summer time, or, in fact, any kind of water in the winter. Then the air being at a lower temperature will absorb more heat. The same is true of all kinds of food cooked in winter, whether cooked on a gas stove or any other kind of a stove.

It is very hard for most men to allow another person to jaw at them without answering back, and when an employee is sent out to investigate a complaint he is often met with a string of epithets directed at all gas men. Occasionally one may get away without making many replies, but leaves the impression that he has been told not to find anything, but just how to act. Another one, however, and I am afraid more frequently so, has the responsibility of the company resting upon his shoulders, or perhaps he does not feel that the company has appreciated him as it should, so he takes it out with the consumer. These cases are rarely brought to the notice of the company, or if they are the man denies and the consumer is not sufficiently reliable to warrant anything being done.

There is another source of trouble to gas companies in the shape of canvassers who go about peddling burners, which they say will give more light at less cost to the consumer. About a year ago a man worked Kansas City in this way. He took an ordinary pillar, put a 12-foot burner into it, then put a small piece of rubber tude over the lower end of the pillar and slipped it down over the pillar on the fixture, having removed the old tip. He had the new burner all ready in his satchel and it took only a second to show the consumer how much larger flame he could have. He also said that the rubber tube expanded so as to keep the gas from burning too fast. It took several months with increased bills to prove this fraud. This fellow charged from 25 cents to several dollars for a complete house set. The new aluminum tip has been used in the same manner in our town, and in the only case I know of the bill has increased. The gasfitter often causes the company trouble by doing poor work, whether from carelessness or incompetency.

There is another reason why the people are displeased with our company. The street railways run to a great many out-of-the-way places in order to increase travel, and the real estate people help by platting new additions and inducing colonies way beyond any possibilities of successful or paying invasion by the gas company. One real estate man has frequently argued that the city council should force the company to extend the mains into all new additions as soon as they are laid out. He claims it the only way to build up a city.

It would seem rather strange after pointing out so many reasons for discontent if I did not make suggestions for ridding ourselves of them, so I offer a few ideas that seem good to me. The first one is to see that all employees are imbued with the idea that the company's interests are of paramount importance. I realize this is not easy to accomplish for obvious reasons. Then we should begin a course of education. I believe a little treatise on the properties and uses of gas would do a great deal of good, especially if it were simply written, showing how it looks, how it smells, how it is dangerous and not different from other gases in this respect, or, in fact, than any other kind of fuel; what it is made of, and so forth. Tell what the process of combustion is and why it explodes under certain conditions; how a person may die in a close room without gas for the same reason as with it, only not so pleasantly. This little book could be given to a customer when he applies for gas and he will be likely to read enough to get a fair idea of its properties. I know that many will throw it down without ever looking beyond the cover, but it will do much good if properly written. As the meter is the most mysterious thing next to the gas itself, I believe a great deal of practical instruction can be given about it, thus relieving the consumer's mind of many suspicions. If we were to have a show meter made of glass, and so constructed as to come apart easily, and place it in a room which could be conveniently darkened, a doubting consumer could be taken in and shown the working of it. When we say a 6-foot burner consumes 6 feet of gas per hour, we could burn it 15 minutes and show that it does. Besides we could open the meter, place an obstruction in the valves and show that the meter can work and not register the gas. Of course, there is a class of consumers who come to kick on the theory that if they don't get the bill reduced it may keep the company from raising any more for a while at least. I believe that some one could add to the usefulness of the meter by inventing a recording dial. One, which by taking a card with a dial printed thereon and slipping it into a groove and pressing a button, the reading could be punched into the card just as it is on the meter dial, and left with the consumer. The date and meter number could be written on the card at the same time.

I submit a table of meter tests made at our works during the year 1901, which shows the small per cent. of faulty meters:

Total number of meters tested during 1901.....							1,120
Number of meters more than 3 per cent. fast							98
" " " " " 3 " slow.....							92
" " " " " 10 " "							1
" " " " " 10 " fast.... . .							0

I believe it the best policy to always treat the consumer better than he treats you. Let him know that you are anxious for him to use gas at the regular price, and if there is anything he does not understand you

are wiling to explain it to him, if, indeed, you know yourself. Of course, you cannot always show him why one family uses more gas than a neighboring one. The water company can easily show its customer by a practical test with a gallon measure, but how the electric man is to prove anything I am at a loss to know.

Our company has at different times given a series of cooking lectures in the form of a school, where a number of foods are made up and cooked on a gas stove before the attendants who are allowed to sample them. This wins a great many friends among the ladies, who are perhaps the hardest kickers and I might say the least reasonable. I will close this paper with the statement that a man must have a very decided control over his temper, for if he looses that, all is lost.

The Future of Coal Gas and Allied Illuminants.—No. I.

[The first of a series of Cantor Lectures, delivered before the Society of Arts, London, England, by PROF. VIVIAN B. LEWES.]

Few of the great industries have undergone such radical changes in condition as have fallen to the lot of gas manufacture during the past 20 years, and my desire in these lectures is to show how these changes have arisen, and the direction in which they tend, together with such side issues as must, of necessity, be satisfactorily settled before the altered condition can bear full fruit for the consumer of gas, and before the gas manager can give his full adhesion to the altered state of things.

When, in the early years of the last century, coal gas became a commercial reality, the one end and aim of the manufacturer was to produce gas, and such details as purity, illuminating and calorific value never troubled his mind. As time passed on, however, and competing companies vied with each other in their endeavor to secure customers, advantages had to be offered to coax customers from the enemy's camp; and those who remember the battle of the two then existing city companies, with another proposed rival in 1847-9, and the way in which the gas consumers in the city were at that period pestered and pamphleted by the rival schemes, will realize that even in those days gas management was not a bed of roses. The outcome of the rivalry was the introduction, in the early fifties, of a standard of illuminating value and a string of parliamentary requirements which have ever since safeguarded the consumer and harried the gas manufacturer.

In 1850 a bill was passed which enacted that a consumption of 5 cubic feet of gas per hour should be equal to the light of 12 wax candles of the size known as sixes, the burner employed being a brass Argand burner with 15 holes. In 1860 another act changed the illuminating power to 12 sperm candles, which meant an increase of some 16½ per cent. in the illuminating value of the gas, owing to the fact that the wax candles originally used were only equal in illuminating power to 10.3 sperm candles as at present employed for testing purposes. In 1868 the illuminating power was again raised to 14 candles, and in 1876 the present 16-candle standard was reached. The amount of light emitted by the gas, however, was still insufficient to satisfy the desires of the consumers, who, utterly ignoring the fact that the illumination to be derived from coal gas is quite as much dependent on the burners employed as it is upon the standard illuminating value, vented their dissatisfaction at the light emitted by small flat flame burners by clamoring for a higher quality of gas; and even 30 years ago the great aim of the gas consuming public was to obtain the highest candle power gas that could be squeezed out of the gas company, in order that they might get something like decent illumination from the flat flame burners then almost exclusively used, and which were, as a rule, so small as to entirely destroy the value of the gas.

It was at this period that the anomaly became common of seeing a town supplied with gas of over 20-candle illuminating value swathed in semi-darkness, whilst another with the much abused 13 or 14-candle gas, supplied at a good pressure and burnt in decent sized burners, was well illuminated. It was at this time also that some of our most able chemists ranged themselves on the side of the votaries of high illuminating power; and even such practical minded men as the late Sir Edward Frankland clamored for the introduction of high illuminating power gas, such as is produced from cannel, in place of 16-candle coal gas. The general line of argument is well shown by portions of Sir Edward Frankland's introduction to the section of his published researches which deals with applied chemistry, in which such paragraphs as the following occur: "Coal gas is not suitable for use in dwelling houses, by reason of its very low illuminating power—100 cubic feet of coal gas contain 4 cubic feet of illuminating gas; the rest is mere rubbish, which heats and pollutes the air in which the gas is consumed. * * * It cannot be too widely known that coal gas, although it costs less per 1,000 cubic feet, is, light for light, much dearer than cannel gas."[1] Even now, when altered circumstances make a high power gas an anything but desirable and economical supply, there are not wanting advocates who, undaunted, are perhaps ignorant of the question, still try to bolster up the old idea.

It was in the latter part of the eighties that the lot of the worried manager was made even harder by a rise in price taking place in cannel coal, on which, up to that time, he had entirely relied, in admixture with ordinary gas coal, to give those higher grades of illumination demanded by the fashion of the time, and which, although it ruined his coke, yet proved an efficient and reliable servant. This increase in price became so serious that about 1890 the Gas Light and Coke Company introduced carburetted water gas in place of cannel as an enricher. This process proved itself a most valuable addition to the manufacture of coal gas, and rapidly gained favor and popularity, not only as giving an easy means of raising the candle power of poor gas, but also as a standby in case of any sudden calls upon the producing power of the works. About this same period also, another method of enrichment was introduced, which consisted of adding to gas which did not fulfil the parliamentary requirements the vapors of such highly volatile hydrocarbons as petroleum spirit and benzol, which, on account of their high illuminating value, gave the necessary increase in the candle power, by the addition of an amount of vapor not likely to afterwards condense from the gas.

Whilst these changes were taking place in gas manufacture, rivals which seemed to threaten its very existence had forced their way to the front. With electric light largely used by the rich, and petroleum reduced to a price at which even the poorest could afford its use as an illuminant, the field of utility seemed to be rapidly disappearing from beneath the feet of the gas industry. But when things were looking at their blackest, there slowly struggled into prominence and commercial success a factor which at once restored gas to its position of primary importance. It was in 1885 that the researches of Dr. Auer von Welsbach culminated in the production of the incandescent mantle, which, frail and unsatisfactory in its earlier forms, was gradually so improved in composition and manufacture that by 1892 it became a brilliant commercial success, and placed in the hands of the gas industry a weapon which rendered its position unassailable in competition with electricity.

Looking at it from a common sense point of view, the incandescent mantle is merely a method of enrichment. Instead of increasing the illuminating power of flame by crowding into the gas more and more hydrocarbons, which during combustion are capable of separating carbon particles, which by their incandescence increase the amount of light emitted by the flame, and *pro rata* the amount of heat, with the mantle you charge the flame with incombustible particles of far greater light emissivity than the carbon possesses, which do their work without that increase in the temperature of the atmosphere inseparable from the other processes. It is the introduction of the incandescent mantle and the improvements which are possible in its construction which really give the possibilities to the gas of the future.

Taking, now, the enriched, or as some prefer to call it, adulterated 16-candle gas as supplied during the nineties, the light which can be obtained from it is entirely dependent upon the burner in which it is consumed, and which may be stated as follows:

Light Emitted per Cubic Foot of 16-Candle Gas Consumed.

Burner.	Candle Unit.
Incandescent—high pressure	30 to 35
" Kern	20 to 25
" ordinary.	14 to 19
Regenerative	7 to 10
Standard Argand	3.20
Ordinary Argand	2.90
Flat flame—No. 7	2.44
" No. 6	2.15
" No. 5	1.87
" No. 4	1.74
" No. 3	1.63
" No. 2	1.22
" No. 1	0.85
" No. 0	0.59

In considering the value given to the gas by these burners, it is seen that according to the method by which the gas is burnt, the consumer may obtain anything from 35 candles down to less than 1 candle per cubic foot of gas. It must also be borne in mind that the burners employed in these tests were all good well made burners, giving the best duty that can be obtained from them; whilst an examination of the burners used in consumers' houses shows that in most cases any anti-

1. Frankland's "Experimental Researches in Pure, Applied and Physical Chemistry," 1877, p. 488.

quated and corroded burner is considered good enough at which to burn the gas, and the very people who are loudest in their complaints as to the quality of the gas are the ones who most disregard the method of its consumption.

Sir George Livesey, in 1900, pointed out that in 50 cases of complaining customers he had the old burners removed and replaced by new ones, when the complaints at once ceased: and on testing the burners so removed it was at once clear that the trouble had been caused entirely by their condition being absolutely unfit for the consumption of illuminating gas. In another case under my own observation, 30 flat-flame burners were collected at random from houses of consumers supplied with the town gas. They were mostly union jet burners, Nos. 3 to 7, and were tested first when consuming 20-candle gas, and subsequently with London gas. With the 20-candle gas the best consumer's burners gave 14.08 candles at the 5 cubic feet rate, and the worst gave 4.34 candles. Of the total number of burners, 30 per cent. gave less than 7 candles at the 5 cubic feet rate, and the average of the whole number made the illuminating value of the gas 8.5 candles. With London gas the best burner gave 10.6 candles at the 5 cubic feet rate, and the worst 3.1 candles; 56 per cent. of the total number gave less than 7 candles at the 5 cubic feet rate. The actual consumption of the burners when supplied with gas under 1½ inches pressure varied from 4.5 to 5 cubic feet per hour; and the consumptions were the same with both kinds of gas.

England is far behind Germany in the use of incandescent lighting An inquiry made this spring into the uses to which the coal gas supply of a large English town was put gave the following results:

	Per Cent.
Incandescent lighting, private	12.0
" " public	6.25
Cooking	23.75
Gas engines and fuel	5.5
Used in other ways	52.5
	100.00

So that 47.5 per cent. is used for purposes in which illuminating power is of no use and calorific effect is the one important factor. It is also seen that 18.25 per cent. of the total gas made is used for incandescent lighting; and this represents about 23 per cent. of the gas used for illuminating purposes, as against 90 per cent. used in this way in Germany. This 23 per cent. thus used gives for a consumption of 5 cubic feet not less than 70 candles, whilst the average light obtained by the combustion of the remaining 77 per cent. is 8.5 candles.

It is quite clear that under such conditions as these the supply of gas of a high candle power is simple waste of money; and it is manifestly unfair that the consumer of average intelligence, who is willing to utilize the benefits given by the incandescent mantle, should have to pay for a quality of gas only rendered necessary by the inertia of those who decline to march with the times.

For many years I have felt and pointed out that the consumer, knowing only that he wants more light and absolutely ignorant of the principles of gas lighting, clamors for a richer gas, whilst the remedy is all the time in his own hands, and the only thing he has to do to attain his desire is to employ rational burners. Men like Sir George Livesey, Mr. Foulis, and Mr. Webber have long since seen the fallacy of high candle power gas, and have fearlessly denounced it; and the time has now come when the principle is being widely grasped, and manufacturer and consumer alike are realizing that cheap gas and plenty of it gives far greater possibilities and better illumination than high illuminating value gas, which must, of necessity, cost more, as in trying to economize by using small burners, the light giving value is destroyed to such an extent that the effect produced is utterly inadequate to the cost.

The arguments brought forward in favor of high power gas and its advantages over low grade gas are, as they always have been, that for a given illumination it is cheaper, fouls the air of a room to a smaller extent, and does not for an equal illumination give as much heat. These contentions were to a great extent fallacious even under the old conditions, as although a 22-candle cannel gas gives 4.4 candles per cubic foot when burnt in a standard flat flame burner, as against the 3.2 candles yielded by the 16-candle gas burnt in the London Argand, directly they come to be used under ordinary consumer's conditions there is little to choose between them, whilst any coign of vantage that cannel gas had entirely disappeared under the conditions which now dominate the gas industry; and it is just Sir Edward Frankland's 96 cubic feet of rubbish which makes the gas of the future.

Two years ago Mr. Webber gave a most interesting lecture before the Gas Institute, taking as a title "The New Gas," which turned out to be simply the low grade gas so widely used with incandescent mantles and for fuel purposes on the Continent. He pointed out that, freed from the trammels created by the Welsbach monopoly in this country, incandescent lighting in Germany had displaced all other forms of gas burners to the extent of over 90 per cent. There is not the least doubt that with improvements and cheapening in the production of mantles, the use of coal gas in this way will rapidly rise in this country to the same dimensions as on the continent.

It will be well at this point to consider the conditions under which the gas manufacturer at present labors, and the ground gas must cover in the future if it is to hold its own. We have not heard so much of late of the working out of our coal supplies, but the fact remains that the best seams of gas coal are getting used up, and coal of this class will soon show an increase in price that will prevent any high quality of of gas being made direct from it without a commensurate rise in the cost the gas. All enriching materials, moreover, fluctuate in price with the demand made upon them, so that if the high illuminating value of coal gas is to be maintained, the probabilities all point to a rise rather than a diminution in price; and even in calculating the probable saving to be obtained by the introduction of gas of lower illuminating power this factor ought to be taken into consideration.

A 16-candle coal gas, when consumed with the incandescent mantle, may mean an 80 to 100-candle gas; and the difference, with properly regulated air supply to the burners, between a 16 and a 12-candle gas is so slight as to be indistinguishable to the eye, whilst the diminution in heating power which accompanies the lowering of illuminating power, although not sufficient to make a large difference to the gas for fuel purposes, yet adds to one's comfort in a dwelling room, where, as a rule, the ventilation is none too good. Coal gas is daily being used more and more as a fuel, and although the slight diminution of calorific value which must of necessity accompany lowering the illuminating value is a slight drawback, yet, in practice, any desired temperature can be obtained by a slightly larger consumption, and a cheapening of the gas would induce many to adopt it as a fuel, this in turn tending to level up the load in production and so render more economies possible.

Everything clearly points in one direction, and that is that the future of coal gas is entirely dependent upon a plentiful supply of low grade gas—low grade from the point of view that it shall only have an illuminating value of 10 to 12 candles, that its heating value shall be as high as can be practically attained, and that its price shall be as low as is consistent with the interests of the consumers as well as with the interests of the shareholders in the gas industry. Already the stream has set in this direction, and the lowering of the parliamentary standard of 16 to 14-candle power in the cases of the South Metropolitan and Commercial Gas Companies will soon be followed by many companies, now saddled with a higher standard than 14 candles, applying for that relief that cannot be, in fairness, refused; whilst experience of the benefits conferred by the reduction will soon lead to the further step that will place gas manufacture in this country on the same advanced footing that already it has gained in the most progressive cities in Germany.

When, however, the change from a 16 or higher candle power down to a 14 or lower illuminating value has been sanctioned by Parliament, the gas manager finds himself confronted with the difficulty that his works have been erected and adapted for making the higher value, and all his practical knowledge is in that direction. His first trouble is to find out how this grave problem is to be overcome, and how the low grade gas can be most economically and best produced. It is with the solution of this question that I now desire to deal.

In attempting to find an answer which will be of practical use, it is no good advancing theories and proposing methods which necessitate such wholesale alterations in plant and procedure as would, to all intents and purposes, mean scrapping the existing generating machinery. The only processes which have a chance of being adopted must be very much on the lines of the old process. If the plant be altered at all, the alteration must be such as can be made at a reasonable outlay, and without serious disturbance to the ordinary working. The gas which is produced must be in all save illuminating value of the same character as the coal gas, of which we know the behavior, and for the consumption of which our stoves and burners have been constructed, special attention being paid to keeping up the calorific value and keeping down the cost.

The logical method of arriving at a conclusion is to first see the composition which would yield ideal results, and to then see what process can be utilized in attaining the nearest approach to this. In order to do this the first point is the effect of the constituents of gas on the results to be obtained from it. The great advantages possessed by coal gas over the fuel gases, properly so called—water gas, Siemens gas, and the hundred and one modifications of them which have been more or less used—con-

sist in the presence of those compounds that we call hydrocarbons; and first and foremost, both in giving size and heating power to the flame, as well as in helping its luminosity, stands methane (CH_4)—a gas which at various periods in its career has been better known as marsh gas or light carburetted hydrogen. A natural product of the decompositions which led to the formation of coal from the monster vegetation of prehistoric times, its presence, ready formed in the coal measures, has proved one of the greatest dangers that the winners of our fuel have had to contend with, as mixed with the air in the workings of a mine it forms the dread fire-damp that has cost so many lives.

The average composition of an ordinary 16-candle coal gas free from enrichment may be stated as follows:

Hydrogen	54.0
Methane and hydrocarbons of the same character	34.0
Ethylene " " " "	3.0
Benzene	1.0
Carbon monoxide	6.0
Nitrogen	2.0
	100.00

All of these, with the exception of the nitrogen, contribute their quota to the heating value of the gas, and their relative values in this direction may be stated as follows:

Gas.	Calorific Value, in British Thermal Units. Gross.	Net.	Illuminating Value per 5 Cubic Feet.	B. T. U.'s per Candle.
Hydrogen	325	272	....	....
Methane	1,024	919	5.2	312.5
Ethylene	1,603	1,510	70.0	114.5
Benzene (vapor)	3,718	3,574	820.0	22.0
Carbon monoxide	330	330	....	....

Applying these thermal values to our coal gas, we obtain:

Hydrogen	54 × 325 =	17,550
Methane	34 × 1,024 =	34,816
Ethylene	3 × 1,603 =	4,809
Benzene	1 × 3,718 =	3,718
Carbon monoxide	6 × 330 =	1,980
		62,873

or 628.73 British thermal units, gross, for a cubic foot, which experience tells us is about the value given by the calorimeter.

It is clear from this that more than one-half the calorific value of our coal gas is due to methane, and more than two-thirds to the mixed hydrocarbons. It is, therefore, evident that these heat-yielding bodies must be fully represented in our future gas.

The only commercial and attainable sources of such hydrocarbons are found in the destructive distillation of coal and mineral oils. Although the hydrocarbon gases *per se* could probably be obtained most cheaply by the cracking of mineral oils, yet we should then be driven back for the large volume of diluting gas (which would be a necessity to lower the illuminating power and cost) to water gas, which, under these circumstances, would be the only available diluent. At once, however, three factors crop up which would immediately negative the use of a low grade carburetted water gas, and these are: (1) that it would forthwith render useless the existing gas plant; (2) that cheap coke being an essential to the manufacture of water gas, the cutting off of the supply of this material would at once render the manufacture of water gas at a commercial price an impossibility; and (3) that blue water gas contains 40 per cent. of carbon monoxide. Although in a 20-candle power carburetted water gas this is reduced to 30 per cent., in a 12-candle power mixture it would rise to 35 or 36 per cent., which under existing circumstances would never be permitted for a domestic supply.

In order to make our view of the subject as complete as possible I shall later on deal with the economic side of a gas supply made on these lines, but I have thought it best to state at this point in a few words my reasons for considering that it never would be adopted. It is evident, therefore, that coal and not oil must be the main factor in producing those hydrocarbons which are to raise the calorific value of the gas to the required point; and we can now discuss the methods by which increased volume and lowered cost can be obtained on this basis.

Amongst the suggestions made for cheapening the manufacture of gas at the expense of illuminating value is that higher temperatures should be employed for retorting the coals; but I think the majority of gas managers will agree with me that the useful maximum temperature has been attained, and that a further pushing of the heats would accentuate troubles which have already shown themselves. If the present practice of using temperatures that yield about 10,000 cubic feet per ton of coal were departed from, the first thing that would make itself felt would be the fact that only a small portion of the gas coal supply is fitted for use at higher temperatures than those now employed, and this limitation would soon tend to raise the price of such kinds of coal as could be used.

According to a highly suggestive paper read by Mr. Harry E. Jones this year on "The Illuminating Power of the Gas of the Future," experiments seem to show that with a Durham coal it is possible to increase the yield of gas per ton of coal by something like 25 per cent., with a total increase in calorific value, by increasing the temperature of carbonization and diminishing the pressure in the retort. Working in the same way I have found results of the same character. But it must be borne in mind that this only means an increase in the volume of gas obtained per ton from 1,000 to 1,250 cubic feel.

The most complete work ever done on the distillation of coal was by Mr. Lewis T. Wright, and the paper which he read at the May meeting of the Incorporated Institution of Gas Engineers in 1895 will long remain one of the most valuable contributions to the subject of carbonization. In it he showed that by pushing the temperature at which distillation was taking place, a rise in volume yielded per ton of a Derbyshire caking coal took place with increased heats till a maximum of 12,190 cubic feet per ton was reached, when the yield gradually fell again; and the same thing was observed with other coals. It seems highly probable that his conclnsion is correct, that the more rapid distillation due to pushing the temperature in the retorts would not be attended by any very marked increase in the yield of gas per ton, as the more rapid evolution of gas in the early stages of the charge would hurry the gases out of the retort, and so prevent their being broken up by the increased temperature. Indeed, on purely theoretical grounds, it is impossible for increased temperatures to give more than a certain increase in volume, as the chief constituents, once formed in the retort, are so stable with regard to heat, owing to their character and to dilution, that but little extra gas is obtained from them, whilst in baking the already formed gas, it is only the higher hydrocarbons that by their decomposition can give any increase, and whilst some of these are decomposed to carbon and hydrogen, others are being synthetically built up into such bodies as naphthaline.

In a recent experiment made under my direction, a poor coal was retorted at the usual temperature, and after the candle power and calorific value had been determined, samples were taken for analysis. The temperature of the retorts was then raised as high as it could be got and fresh determinations made, with the following resulst:

	I. Ordinary Temperature.	II. High Temperature.
Hydrogen	51.11	54.68
Saturated hydrocarbons	36.39	32.32
Unsaturated hydrocarbons	4.50	4.00
Carbon monoxide	7.00	7.00
Carbon dioxide	nil	nil
Oxygen	nil	nil
Nitrogen	1.00	2.00
	100.00	100.00

	Illuminating Value.	Calorific Value. Gross	Net.
I	15.2	612	556
II	14.6	596	532

Showing that the action taking place was an increase in the volume of hydrogen at the expense of the hydrocarbons present. Where it has been possible to further increase the temperature of carbonization the action has been still more marked.

If, instead of taking a poor coal, as was done in this case, and using the ordinary retort temperature, which gives, in the first case, a large amount of hydrogen in the gas, a rich Newcastle coal is taken and is retorted first at a low temperature (dull red), and is then carbonized at the highest attainable temperature (bright orange), this action is still more striking. As far back as 1884 Mr. Lewis T. Wright made an experiment of this character, with the following results:

	I. Dull Red.	II. Bright Orange.
Hydrogen	38.09	48.02
Saturated hydrocarbons	42.72	30.70
Unsaturated hydrocarbons	7.55	4.51
Carbon monoxide	8.72	13.96
Nitrogen	2.92	2.81
	100.00	100.00
	I.	II.
Illuminating value	20.5	15.6
Cubic feet per ton	8,250	12.006
Calorific value, B.T.U's (calc.)	811.0	588.8

It is here again evident that the breaking down of the hydrocarbons into hydrogen and carbon has given the increase in volume, and whilst

there has been an increase in the candles per ton of coal carbonized amounting to 10.3 per cent., the increase in calorific value per ton is only 5.6 per cent.

A large increase of temperature above that at present employed would, moreover, result in such trouble from stoppage of ascension pipes by pitch, and from naphthaline in the service pipes and mains, not to mention the increased quantity of sulphur compounds and the reduction in ammonia and tar, that, leaving out the question of wear and tear and fuel, such a method of increasing the yield could never be successful.

There is, however, another phase of the question, and that is that by employing inferior coal bought at a cheaper rate and retorting it at the highest temperatures found compatible with economical working, the low grade gas of good calorific value might be obtained direct. But the economy to be attained would be very small.

The method, however, of abtaining a low grade gas which would be most welcome to the gas manager, and would comply with the necessities of the future, would be to in no way alter the working or arrangement of the present plant, to make the same gas as heretofore, and to dilute it down to the required point by a combustible dlluent which must be cheap enough to offer sound economical advantages, and yet of sufficient calorific value to keep up the heating power of the mixture to the needed point.

The only gaseous mixtures which are available for this purpose are either water gas pure and simple or mixtures containing water gas as their basis. A glance at the calorific values of the so-called fuel gases makes this at once apparent.

Water gas	328 gross.
Producer gas—Dowson	150 "
" Mond	155 "

Indeed, with the exception of water gas, the so-called fuel gases, containing about two-thirds of their volume of inert nitrogen, and being of high specific gravity as compared with coal gas, do not lend themselves to distribution.

Blue water gas, as it is customary to call the non-luminous mixture of hydrogen and carbon monoxide generated by the action of steam on incandescent carbon, first made its appearance in this country on a manufacturing scale in 1887–8, as a fuel where high local temperatures were necessary. Shortly afterwards carburetted water gas, a mixture of water gas and oil gas, was, as already mentioned, introduced at Beckton as an enricher of coal gas, in the place of cannel coal, which had at that time risen to prohibitive prices. The ease and rapidity of manufacture at once secured it a complete success, and at the present time very few large gas works are without this valuable auxiliary.

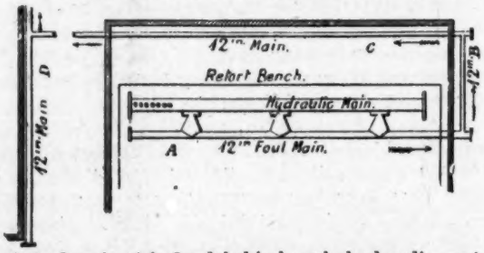
The attitude of the public towards this new introduction was at first one of apathy, but presently the gentlemen who delight in writing to the daily papers and seeing their names in print, recognized a golden opportunity for self-advertisement, and the public were informed that death and every form of horror were being let loose upon them. The exaggerated and mostly utterly false statements of the early agitators being to an extent supported by well-known and well-meaning medical practitioners, who had plenty of book-lore and little or no experience of the subject, a crusade against water gas was started, which culminated in 1898 in the appointment of a Departmental Committee to inquire into the subject. Their report was issued in 1899, and it is probable that some legislation on the subject will shortly be brought forward.

[To be Continued.]

The Naphthaline Trouble.

Mr. Charles Read, of Redhill, writing in the *Journal of Gas Lighting* on this topic, remarks that it still appears to be worrying the brains of engineers and managers. I have read with interest the papers that have been produced at various meetings, also the discussions that have followed; and I must express my surprise that the subject has been such a difficult one to solve, when, in my opinion, it is simple enough. However, I will give my experience.

When taking the management of the Redhill Gas Works 30 years ago, the method then employed was to take the gas out of the top, and the tar out of the end of the hydraulic mains; the tar running direct into the tar well. The gas, with such light tarry matters as it contained, was conveyed to a vertical condenser composed of two rows of 5-inch cast iron pipes, and thence to a small scrubber for a distance of about 80 feet. This pipe was in the ground. By this process naphthaline was produced in abundance; all the pipes having to be steamed out about four times a year. With 50 pounds pressure of steam driving direct into these pipes, it would take about 30 minutes before any impression could be made upon it; and then it would burst forth like a volcano. This state of things I could not allow to continue; so I set about altering the method of condensation, for here lies the secret of all the trouble. My method of procedure will be understood from the accompanying sketch, which shows half of the retort house and one hydraulic main.



A 12-inch foul main *A* is fixed behind each hydraulic main, having three openings forming outlets for the gas, tar, etc., which travel together round the 12-inch pipe *A*, *B*, *C;* the other side of the house being the same. After going round the retort house, these two foul mains join another running along the wall of another retort house. Having travelled this single pipe for a distance of about 50 feet, the heavy tar is drawn off by a 2-inch pipe (the old vertical condenser being dispensed with); main thermometers being placed in the foul main at various distances. The gas, with such light tar as it may contain, then traverses another 12-inch main, made of wrought iron, round the purifier house, all under cover—no part being exposed direct to the sun's rays—for a distance of about 200 feet, and having a gentle back-fall to the point where the heavy tar is drawn off, and forms an excellent condenser.

I feel assured that if engineers and managers would dispense with their vertical pipe and battery condensers, especially where they are exposed direct to the sun's rays, and adopt a horizontal main similar to the one I have described, all their naphthaline troubles would very soon disappear, and peace and contentment reign—a condition of things which the Redhill Gas Company have enjoyed for the past 28 years.

Blast Furnace Gas Engines and Their Work.—I.[1]

Director Reinhardt, of Dortmund, Germany, has presented at the meeting of the Verein Deutscher Eisenhuettenleute an admirable paper on modern blast furnace gas engines, which is both descriptive and critical, and gives a great deal of information which has not yet been brought to the attention of the metallurgical world. We take from it the following data:

In comparison of motors a series of considerations must be taken into account which I will enumerate in the order in which they appeared to me to possess importance:

1. Security in operation.
2. Quiet running.
3. Accessibility of those parts which must be most frequently inspected and cleaned.
4. Regulation.
5. First cost.
6. Consumption of lubricants.
7. Number of calories required per horse power.
8. Space occupied.
9. Points affecting the coupling to dynamos or blowing engines.
10. Consumption of water.
11. Balancing of masses.
12. Elegance of design.

Naturally this order will be somewhat changed according to special considerations.

Before taking up individual designs I desire to say a few words concerning the Otto 4-cycle motor, which is now being built by all engine works, and to give some data relative to its operation. The single acting 4-cycle motor is generally and exclusively used for larger units without guides or cross heads, as indicated in Fig. 1, so that the cylinder itself represents the guides and the long piston takes the functions of the cross head. This type of motor can, of course, be produced more cheaply than the cross head motor and is, therefore, preferred by those selling engines. It is stated also that experience has proved that the gas consumption is less than that of a motor with cross head. This may possibly be explained by the fact that it is very difficult to attain absolute accuracy in building together the cylinder and the guides and to bring into line the

1. *Iron Age.*

cross head with its connections. The result is that probably with every stroke the piston rod bends and therefore brings about unnecessary friction. But after a cylinder has undergone a certain amount of wear this friction disappears; then, according to my opinion, there is no reason for a larger consumption of gas in the case of cross head motors.

It is the practice in many, although not all, gas engine works to fit the piston during the trial run at the works under loads gradually increased in such a manner that at its maximum power it does not pound and has a bearing all over. This is done not alone because the piston when performing the function of a cross head must accurately fit into its guides, but also because the piston itself and not rings alone must contribute to the packing. The work of fitting requires very experienced men, because the piston expands more freely than the cylinder, so that those parts which must be removed from the piston are indicated only by increased friction. The workmen can only estimate by hearing the time when those parts which bind are sufficiently indicated without any injury to the cylinder. Further on we shall see what value this difficult piece of work has in the long run.

As a rule the gas engine has from 5 to 10 piston rings, all of which in the case of the piston motor are located at the back end of the piston between the piston end and the piston bolt. These rings wear out the cylinder by their 10 to 20 edges in presence of the unavoidable residues of combustion very much more rapidly than is the case in steam engines. The front part of the cylinder, which is not touched by the rings, shows almost no wear, while the middle part of the cylinder, which is in contact with all of the rings, shows the greatest wear. As indicated in Fig. 1, the wear decreases toward the end. The result of this is that in time

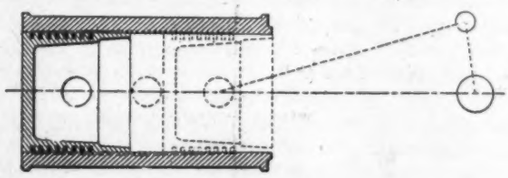


Fig. 1.—Section of Piston.

a ridge forms in the cylinder near the crank end, which makes it difficult to take out the piston. Therefore this ridge must be as frequently removed as is possible, so that the piston may be withdrawn later on. Besides this, the space between the inner surface of the piston rings and of the piston proper in the ring notches fills up with oil and the products of combustion. These substances adhere by burning, so that the rings do not have as much play as they had at first, and often they stick altogether, a thing that may lead to leakage of the piston.

It is a very difficult thing under such circumstances, in the case of older engines, to take out that part of the piston which is supplied with the rings which cannot be longer compressed. For this reason it is well to take out the piston more frequently, even when there is no direct cause for the operation, and to clean the rings in the well-known manner. For large engines this is certainly a disagreeable feature. The causes might be lessened to some extent if the rings were distributed over the entire length of the piston, so that one ring at least covers its course the entire length of the cylinder. It is urged against this arrangement, which has been adopted by some, that the first ring is apt to strip off the oil and to eject it from the cylinder, so that the result is an excessive consumption of lubricant.

The wear of the cylinder referred to is usually so large in the first few months that accurate fitting of the piston has become valueless. The piston acting as a cross head has thus developed play in its guides. Particularly during the compression stroke it is lifted and then falls back again. In the case of small engines the blows thus created are not of importance, but they are very troublesome with large engines, particularly when the piston bolt does not pass through the center of gravity of the piston.

A further result of the wearing of the cylinder is that the piston itself does not contribute to packing, and unless the rings from the outstart or by corresponding wear do not perform this function the motor leaks. It is, therefore, well to depend upon the rings at the outstart for preventing leakage, and to give up the plan of fitting the piston. For larger powers only engines with guides and cross head should be purchased.

The cross head motor has the further advantage that the cross head bearing, which is one of the most difficult details with large engines, is no longer placed in the hot piston, where it always proves troublesome. Besides, the same number of piston rings might be distributed over a greater length, and in that manner leakage might be avoided and uniform wear of the cylinder be reached. A further property of the single acting 4-cycle motor, at least one designed as a cross head motor, is the exceptionally quiet working of the connections. This is due to the fact that the alterations in pressure always take place under favorable circumstances. As contrasted with the steam engine, the loading of the motor has no influence upon this quiet action, at least in those cases when the regulation does not at the same time change the degree of compression. Therefore it is the general practice to regard as superfluous in the case of the ordinary 4-cycle motor an arrangement for taking up wear of the crank bearing. The construction becomes a simple one and permits the use of economical oiling appliances.

A further advantage of the open 4-cycle motor is that the piston can be readily taken out for the purpose of cleaning so long as the wear of the piston has not become excessive. It is possible, too, to control the tightness of the piston and to a certain extent the oiling of the same when it is in operation.

When the piston becomes increasingly leaky, the efficiency declines and the exhaust gases eject the cylinder oil, thus raising the temperature of the surfaces and causing corrosion of the piston or the rings and the cylinder. It is certainly a matter of great importance that in the case of the open 4-cycle motor this fact may be at once observed and may be counteracted, at least for a short time, by a more liberal use of lubricant and possibly by stopping the engine at the right time.

The simple construction and the undoubted advantages of the open 4-cycle motor were possibly the reasons why the designers were loath to abandon it when taking up the building of large engines. The disadvantages – namely, the relatively low uniformity, which cannot even be expressed in the case of arranging the 4 cycle motor as a duplicate machine, and furthermore the probable limits in the size of the parts—led to different combinations of the 4-cycle cylinder. In the case of all these engines the maximum size of the unit was limited by fear as to the safety of the cylinder heads for large sizes. In small gas engines the inlet valve is usually placed below and the exhaust valve at the side of the cylinder head in a casing screwed onto the same. It is a rare occurrence that the heads, which are arranged ball shape in the interior, become defective. This is generally the result of a heavy deposit of scale in the cooling jacket, or of freezing in winter. With reference to the valve motion, one valve, in the case of larger motors, has been placed in the lower part of the cylinder head and the other vertically above it. This arrangement, in itself, good so long as it was a question only of two valves, requiring specially fitted valve cages, and it was not always practical to attain easy cleaning of the valve, because in order to affect this the whole valve cage had to be removed, and under certain circumstances a part of the valve gear had to be taken down. An effort to meet this difficulty has been made by placing both valves side by side in the inner wall and locating above each valve a tubular opening closed by cover and through which the valve could be readily drawn out upward.

So far as the cleaning of the valves and the inner part of the cylinder head is concerned this design is therefore advantageous, but it leads to an unfavorable shape of the cylinder head with reference both to the surface of the compression chamber and to the danger which lies in a short stiff connection between the outer and inner walls of the cylinder head at places which are exposed to stresses due to the different temperatures between the outer and the inner wall. Soon after these heads were introduced the reports appeared that they cracked very readily, particularly so far as the outer wall exposed to tension stresses is concerned.

This began the difficulties with the cylinder heads, and they increased still more since designers did not immediately decide in the case of the larger cylinder heads to return to the former design of two valves placed one above the other, the outlet valve being cooled with water through a hollow spindle. Designers persisted in the construction of four valves placed side by side in the lower inner wall. Now that the better arrangement has been adopted with all larger 4-cycle motors the hope seems justified that danger of cracking is not as great as it was at one time. The new heads of the larger engines are generally made of annealed steel castings, so that it is probable that so far as material is concerned they cannot be very much improved.

I am inclined to doubt, however, whether cast iron cylinder heads which have cracked, when supplanted by steel castings will prove more durable in the long run, particularly if there has been no change in the design.

Mr. Reinhardt goes into a somewhat elaborate discussion of this point which we need not reproduce at this time.

A further danger in the case of large cylinder heads is the thickness of the cylinder head flange, Fig. 2. This flange is cooled only at one

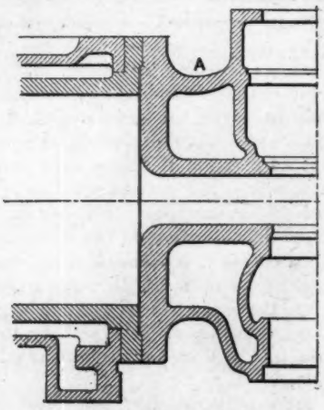


Fig. 2.—Section of Cylinder Head.

surface, and is exposed to the highest temperatures on the other surface, the contrast being particularly great as compared with the outer wall *A*. A very heavy flange is therefore very dangerous in itself, even if it is cooled, because the accumulation of heat creates stresses upon the rim.

Questions addressed to the steel works which have gas engines in operation have shown that many of them did not at first work quite satisfactorily, but that the builders have succeeded in putting the plant into a satisfactory condition. It must be admitted that the gas engine, aside from the new designs which have been planned by some firms, has proved on the whole a machine which can be utilized by the iron industry.

I must confess that the following difficulties seem to me to be likely to affect adversely the introduction of the gas engine and the value of those already in operation: The difficulties of starting in the case of poor gas, or of correct position of the gas valve, the loss of time which grows out of repeated failure to start, so that the air tank must be pumped full again; the premature ignition which is to be feared at certain intervals with large engines; the disturbances created by possible refusal of the igniting appliance; the necessity of removing the piston and the valves for the sake of cleaning them, which occurs frequently as compared with steam engines; the irregularities in running with many gas engines when they are lightly loaded, or run without a load, and the experiences with some cylinder head designs and some cylinder arrangements.

Apparently all these disturbances do not occur as often or are not so troublesome as was thought probable, as the works' engineers have soon accepted them, reaching the conclusion that they must be taken into the bargain in view of the other advantages of the gas engines. It seems that the device of starting with compressed air works without trouble. Against poor gas in starting provision may be made by allowing gas to escape, after prolonged stops of the engines, until it burns with a long, blue flame, and certainty of igniting may be attained by arranging for two igniting devices. Starting a cold engine is sometimes difficult, particularly when moisture has developed in the interior and specially in the igniting apparatus, so that there is no spark. In order to prevent this, steam has been introduced into the water jacket of the cylinder head, and it is sufficient, too, to take out the igniting apparatus and warm it.

A short review of the development of the gas engine in iron manufacture shows at the outstart that the Oechelhaeuser 2-cycle motor was competing with the 4-cycle engine without leading to any remarkable progress in either system. Possibly the reason was that the early Oechelhaeuser engine, as at first installed at Hoerde, worked with a mixture pump, and, therefore, there was a large quantity of explosive mixture before the working cylinder. The regulation, too, was inadequate; the whole engine was not simple and required much room in spite of the fact that there was no valve gear on the working cylinder. It was known, too, that one of the crank shafts had broken.

In brief, the representatives of the single acting 4-cycle motor did not believe it necessary to make special efforts in competition with the early type of the Oechselhaeuser engine. The result was that there appeared, almost simultaneously, the well-known 4-cycle combination of the Gasmotorenfabrik Deutz of the Société Cockerill at Seraing, of Gebrueder Koerting and of the Maschinenbau Gesellschaft Nuernberg.

In the meantime Koerting busied himself with the building and testing of first a double acting 4-cycle motor and later a double acting 2-cycle motor, with the well-known success. Koerting's success was probably the reason why other gas engine builders took up the revision of their ideas and now recommend the double acting 4-cycle motor as the best engine.

With all these engines the igniting is now only effected by the electric spark. Water cooling of the piston has been generally adopted for cylinders of 150-horse power and upward. It is a minor complication which has proven effective. It is certain that the cooling of the piston reduces leakage, decreases the consumption of lubricants, lessens the chances of premature ignition by the burning on and glowing of a crust on the piston end and the clogging of the piston rings. A cooled piston need not be taken out so frequently to be cleaned as is necessary with an uncooled piston. Packing boxes are also quite generally used with gas engines without giving more trouble than they do with large steam engines.

ITEMS OF INTEREST FROM VARIOUS LOCALITIES.

Mr. H. Russell has resigned the position of Assistant Superintendent to the Detroit Gas Company so that he might assume the duties of Superintendent of Works to the San Francisco Gas and Electric Company.

The Salinas (Cal.) Gas and Electrical Appliance Company has sold its business to the Salinas Water, Light and Power Company.

At a meeting of the shareholders in the Niagara (N. Y.) Light, Heat and Power Company, the following officers were elected: Directors, John W. Fisher, George P. Smith, L. T. Palmer, George A. Lewis and W. S. Wende; President, John W. Fisher, Buffalo, N. Y.; Vice-President, George P. Smith, North Tonawanda, N. Y.; Secretary and General Manager, L. T. Palmer, North Tonawanda, N. Y.; Treasurer, George A Lewis, Boston, Mass.

The annual report of the Buffalo (N. Y.) Gas Company, shows that the net earnings, for the year ended September 30, were $339,137. The interest on the Company's bonded debt for the year was $290,250, leaving a net profit of $48,887. For the previous year the surplus earnings after the payment of interest amounted to $13,689.

It is said that the proprietors of the Central Light and Power Company, which was organized in 1893 to do a lighting business in Rochester, N. Y., propose to establish a plant to compete with the Rochester Gas and Electric Company. The officers of the concern are: Directors, J. De Witt Butts, John Ladwig, F. S. MacComber and E. V. Stoddard; Secretary, F. S. MacComber; Treasurer, John Ladwig.

Messrs. H. G. Barnes, Jas. Lynn, W. H. Glenn and T. S. Atkinson have petitioned the authorities of Paulding, O., for the right to there construct and operate a gas works.

Mr. W. H. Pearson, General Manager of the Consumers Gas Company, of Toronto, Can., has arranged for the installation of additional water gas plant up to a daily output of 800,000 cubic feet.

A correspondent forwards the following from Grand Rapids, Mich., under date of the 4th inst.: "Mr. Joseph Brewer, of this city, when recently asked about the application of himself and others to the authorities of Holland, Mich., for the right to operate a gas plant in Holland, said: 'The published reports that we have filed that application on behalf of some other parties is wholly without foundation. The application was made by H. B. Webber, of Ionia, Charles H. Bender and myself for ourselves and no one else. Mr. Webber now owns gas plants at Ionia and at Traverse City. If we secure the franchise asked for, and we expect favorable action by the Holland Council, we will put in a gas plant at Holland. No other parties in this city or elsewhere are interested with us.'"

The Equitable Illuminating Gas Light Company, of Philadelphia, has declared a semi-annual dividend of 3 per cent., payable to-day.

The voters of Ashton, Ills., will shortly be called upon to ballot as to the advisability of bonding the town for the purpose of raising the funds necessary to construct a lighting plant.

A correspondent forwards the following from Indianapolis, Ind., under date of the 6th inst.: "If the Indianapolis Gas Company's sales

of artificial gas for the half year just ending increases as much over the preceding 6 months as they did in the 6 months ending June 20, the price of the gas will be reduced to 95 cents per 1,000 under the ordinance. The ordinance provides that when the sales for a year exceed 300,000,000 cubic feet, the price shall be reduced from $1 per 1,000 to 95 cents, and that when they exceed 350,000,000 cubic feet, the rate shall be reduced to 90 cents per 1,000. The semi-annual report of the Company to the City Comptroller, for the 6 months between June 20, 1901, and December 20, 1901, showed that the sales aggregated 114,568,000 feet. For the half year from December 20, 1901, to June 20, 1902, the sales were 141 689,900 feet. Thus the sales increased 27,121,900 in the 6 months ending June 20, 1902, over the half year ending December 20, 1901. If this rate of increase has been maintained, it would make the sales for the year between December 20, 1901, and December 20, 1902, 310,421,700 cubic feet, or about 10,000,000 cubic feet more than enough to obtain the reduction in price. Some of the city officials believe the increase has been even greater than this because of the large number of people in apartment houses and elsewhere that are using artificial gas for cooking. The Company's next report will cover the time up to the 20th of this month. It probably will not be filed until after the first of the year, but if there is a reduction it will go in effect in time for the January bills. The reports are sworn to by S. D. Pray, Secretary. He says he has not made any totals, but that he will not be greatly surprised, in the light of the increase shown by the last report, if the figure should run over 300,000,000. If it does not this time, it is only a question of a few more months until it will, he says. The city officials feel that another year at the farthest will see the sales pas the 350,000,000 mark, and the price drop to 90 cents."

THE incorporation of the Acme Gas Company, with headquarters in Newark, N. J., by Messrs. Burton W. Gibson, Thomas G. Barnes, Joathan Holden, Stephen Callaghan and Nathan F. Griffith, is announced. It is capitalized in $1,000,000, of which sum $1,000 is paid in. Its named object is to deal in gas plants generally.

THE Davenport (Ia.) Gas and Electric Company has arranged for the placing of a 600 kw. alternator to be driven by a 1,000-horse power engine. It will also add to its electrical outfit 3 Brush arc machines of 125 lights each.

THE time for holding the annual meeting of the San Francisco Gas and Electric Company has been changed from January 21st to April 21st. It looks that some sort of a truce will be patched up shortly in connection with the gas and electric lighting service of the city. Even the Spreckles contingent can tire of losing money.

MR. PATRICK F. DUFFY, for many years the efficient Superintendent at Jamestown, N. Y, for the Pennsylvania Gas Company, died at his home in that city some days ago. He was in his 47th year.

THE proprietors of the Orange County Gas and Electric Company, of Middletown, N. Y., have ordered a reduction in the rate for gas sold on fuel and power account of 25 cents per 1,000 cubic feet—to $1.10 from $1.35.

MESSRS. W. E. STEINWEDELL, P. Plantinga, Arthur M. Smith, Frederic C. Howe and Walter Lucas have filed formal notice of the incorporation of the Gas Machinery Company, with headquarters and shops in Cleveland, O. The Company is capitalized in $50,000.

THE gas works at Pomona, Cal., in so far as the generating division thereof is concerned, will be remodeled for operation on the Lowe type of crude oil working.

THE corporate title of the Baraboo (Wis.) Gas and Electric Light Company has been or is about to be changed to that of the Baraboo Lighting Company. Messrs. George Mayers and John Brown, of Chicago, are interested with Messrs. B. H. Strong, Daniel Ruggles and C. L. McFarland, of Baraboo, in the direction of the Company.

AT the hearing before the Massachusetts Board of Gas and Electric Light Commissioners, on the petition of the East Boston Gas Company for permission to increase its capital stock in the sum of $55,000, no one appeared in opposition. Decision was reserved.

MR. GEORGE PORTER, JR., who is the main man in the development of the projected gas plant for the Prescott (Ariz.) Gas and Improvement Company, asserts positively that the works will be completed by September 1st.

THE Lowe family have incorporated the Los Angeles (Cal.) Independent Gas Company, the baptism of which was made in a capital stock naming of $5,000,000—only $5,000 thereof, however, has been subscribed. The Directors are: T. S. C. Lowe, T. Lowe, Caroline W. Dobbins, Lynn Holm and A. H. Bronson. We wonder how much stock Caroline W. Dobbins subscribed and will pay for.

MR. L. K. DAVIS, of Indianapolis, Ind., has purchased the gas and electric lighting systems of Martinsville, Ind. He will rebuild both the plants, for the sufficient reason put forth by himself that "As they now stand they are practically nothing else than junk." The contract for the gas reconstruction has been awarded to the United Gas Improvement Company, and the Western Electrical Supply Company, of St. Louis, will rebuild the electrical division of the Martinsville plant.

A RECENT issue of the *Staten-Islander*, a representative newspaper of the Borough of Richmond, N. Y., had this to say respecting the gas service of that place, which for some time has been carried on by the New York and Richmond Gas Company, a concern that is controlled by Mr. F. H. Shelton and his associates: "There was a time on Staten Island when one of the chief causes of complaint was the low qualiiy of gas and the high price charged for it. The Gas Company was a grievance, year in and year out; now it is a benefit and a blessing. This is not a fairy tale, or a mysterious transformation. It is simply that a new Company, the New York and Richmond Gas Company, has been created out of the old one, and that a live, businesslike and public spirited concern has grown out of the obsolete and mouldy corporation of earlier days. It is not too much to say that this has been due not only to the sound sense and honest purpose of the new owners of the plant, but very largely to the intelligent industry and common sense of one man, and that man is the General Manager, Mr. Thomas O. Horton. Popular personally and with the address of an experienced man of affairs, he has so handled the property entrusted to his direction by those who were wise enough to choose the right man, that he has improved the gas, the service, the rate and the temper of the consumers." How the self-contained, unobtrusive, but persistent and convincing gentleman that he is—General Manager Horton—must have nervously shifted his eyeglasses when he read the *Staten-Islander's* comment. The best of it all, though, is that the comment is justly deserved by Company and man.

RESIDENTS of Sandy Hill, N. Y., have been granted a franchise for the construction and operation of a gas works at Bennington, Vt. It is stipulated that the maximum selling rate shall not exceed $1.50 per 1,000 cubic feet, and it is further agreed that at the end of 10 years from the date that gas is first sent out the authorities may purchase the plant for operation on public account, the purchase price to be the original cost of the system, plus 10 per cent.

SENATOR TUCKER has presented to the Rhode Island Legislature a bill to incorporate the South County Gas and Power Company. It is thought that this may have to do with certain proposed consolidations in Providence and other districts adjacent thereto.

SUPERINTENDENT WALSH has arranged for a system of main extensions to the existing service of the Wichita (Kas.) Gas and Electric Light Company that will call for an expenditure of $15,000.

A CORRESPONDENT in Boulder, Col., forwards the following under date of the 5th inst.: "Another large enterprise was added to Boulder's industries yesterday when the Boulder gas works sent out its first gas. To-morrow the Company will begin regular work. The opening of this enterprise has been delayed on account of the inability of the railroad to furnish material as fast as needed. The plant is located in the Company's 40 by 94 brick building on Thirteenth street, and is equipped with the best machinery, fixtures and apparatus obtainable. The plant represents an outlay of $50,000 and its two large generators have a daily capacity of 250,000 cubic feet and the holder of 50,000 cubic feet."

MR. SALEM HOWE WALES, a prominent figure in both the municipal and business life of New York city, and for nearly 24 years managing editor of *The Scientific American*, died December 2, of apoplexy. He

(*Continued on page* 874.)

THE AMERICAN GAS LIGHT JOURNAL

A. M. CALLENDER & CO.,
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Notification Respecting Advertising.—Orders for new advertising, or for changes in standing advertisements, to insure attention in the issue following their reception, must be in hand any time of Wednesday.

AGENTS:

New York—American News Co. 39 and 41 Chambers St.
Germany—Lemcke & Buechner, of New York.
England—Aug. Siegle, 30 Lime Street, London.

MONDAY, DECEMBER 15, 1902.

(*Continued from page* 873.)

was born in Wales, Mass., in 1825, and came to New York in 1846, where 2 years later he became associated with *The Scientific American*. In 1855 he was appointed New York State Commissioner at the Paris Exhibition. In 1873 he was made Park Commissioner of New York, and later became President of the Commission, and besides a number of years in this service was also for a time President of the Dock Department. He was one of the early Commissioners of the New East River Bridge, was one of the founders of the Metropolitan Museum of Art and a director and member of a large number of institutions of business, art, science and charity.

The Market for Gas Securities.

The peculiar conditions prevailing in the money market are making it rather uncomfortable for those who have been trading on the long side recently; but the safe man is the one who fears not the money rate, for as he can buy for cash, and buy outright, it makes little difference what current call or time loans are commanding. Despite the ominous appearance of ruling values in Consolidated gas, we notice that several small lots were taken for cash "in and about" 210, and further orders were given for other small lots at that figure or under. It seems queer that these shares should be selling at the quoted rates, when the absolute business of the Company is showing the greatest gain ever made in its history, no matter with what period the comparison is made. Buy Consolidated and you'll be on the right side. City gas bonds are decidedly on the high side; and the little floating Mutual that is left is bid for often.

Brooklyn Union is at the nominal figure of 219 to 225, while the Company's earnings for the current year must certainly have been equal to 16 per cent., wasteful and all as its management has been. Peoples, of Chicago, is strong, and the shares are undoubtedly a buy. Baltimore Consolidated is as before, and Bay State gas is said "to have gone" to 1½. The United Gas Improvement Company's regular quarterly dividend of 2 per cent. is payable the 15th prox., and at the current Philadelphia prices there should be good profit in the purchase thereof.

Gas Stocks.

Quotations by George W. Close, Broker and Dealer in Gas Stocks.

16 WALL STREET, NEW YORK CITY.

DECEMBER 15.

☞All communications will receive particular attention.

☞The following quotations are based on the par value of $100 per share.

N. Y. City Companies.	*Capital.*	*Par.*	*Bid.*	*Asked.*
Consolidated	$73,177,000	100	208¾	209
Central Union, Bonds, 5's	3,000,000	1,000	110	112
Equitable Bonds, 6's	1,000,000	1,000	105	..
" 1st Con. 5's	2,300,000	1,000	118	120
Metropolitan Bonds	658,000	..	108	112
Mutual	3,500,000	100	350	..
Municipal Bonds	750,000	..	..	..
New Amsterdam Gas Co..				
Bonds, 5's	11,000,000	1,000	112½	113
Northern Union, Bonds, 5's.	1,250,000	1,000	108	110
New York and East River..				
Bonds 1st 5's	3,500,000	1,000	112	113
" 1st Con. 5's	1,500,000	..	109	111
Standard	5,000,000	100	130	140
Preferred	5,000,000	100	150	160
Bonds, 1st Mortgage, 5's	1,500,000	1,000	115½	118
Yonkers	299,650	500	130	
Out-of-Town Companies.				
Brooklyn Union	15,000,000	100	219	225
" " Bonds (5's)	15,000,000	1,000	119	119½
Bay State	50,000,000	50	1¾	1¾
" Income Bonds	2,000,000	1,000	.	75
Binghamton Gas Works..	450,000	100	28	30
" 1st Mtg. 5's	500,000	1,000	98	96
Boston United Gas Co.—				
1st Series S. F. Trust	7,000,000	1,000	82	85
2d " " "	3,000,000	1,000	47½	50
Buffalo City Gas Co.	5,500,000	100	7½	10
" " Bonds, 5's	5,256,000	1,000	75	77
Capital, Sacramento	500,000	50	..	35
Bonds (6's)	150,000	1,000		
Central San Francisco	000,000	..	105	108
Chicago Gas Co. Guaranteed Gold Bonds	7,650,000	1,000	104	104½
Cincinnati Gas & Elec. Co..	29,500,000	100	99½	101
Columbus (O.) Gas Co., 1st Mortgage Bonds	1,500,000	1,000	101	101½
Columbus (O.) Gas Lt. & Heating Co	1,682,750	100	88¾	89¼
Preferred	3,025,500	100	107½	109
Consumers, Jersey City Bonds	600,000	1,000	103	106
Consumers, Toronto	1,700,000	50	218	225
Consolidated, Baltimore	11,000,000	100	..	71
Mortgage, 6's	3,000,000	..	..	115
Chesapeake, 1st 6's	1,000,000	..	..	..
Equitable, 1st 6's	910,000	..	..	..
Consolidated, 1st 5's	1,490 000	..	.	112
Consolidated Gas Co. of N.J.	1,000,000	100	15	17
" Con. Mtg. 5's	880,000	1,000	85	87
Consolidated G. & E. Co.'s. Little Falls, N.Y.	90,000	100	..	100
Bonds	75,000	..	..	100
Detroit City Gas Co	4,825,500	50	.	89
" Prior Lien 5's	5,003,000	1,000	99½	100
Detroit Gas Co., 5's	362,000	1,000	77	79
" Inc. 5's	16,000	100	94	94½
Equitable Gas & Fuel Co., Chicago, Bonds	2,000,000	1,000	..	101
Essex and Hudson Gas Co.	6,500,000	..	34	38
Fort Wayne	2,000,000	..	.	.
" Bonds	2,000,000	..	55	..
Grand Rapids Gas Lt. Co. 1st Mtg. 5's	1,225,000	1,000	104½	105
Hartford	750,000	25	245	265
Hudson County Gas Co., of New Jersey	10,500,000	..	25	..
" Bonds, 5's	10,500,000	..	101	103
Indianapolis	2,000,000	..	..	68½
" Bonds, 6's	2,650,000	..	102	105
Jackson Gas Co	250,000	50	73	75
" 1st Mtg. 5's	290,000	1,000	101	102½
Kansas City Gas Light Co., of Missouri	5,000,000	100	..	36
Bonds, 1st 5's	3,822,000	1,000	102	104
Laclede, St. Louis	10,000,000	100	80	90
Preferred	2,500,000	100	100	110
Bonds	10,000,000	1,000	109½	110
Lafayette Gas Co., Ind	1,000,000	100		60
Bonds	1,000,000	1,000	60	65
Louisville	2,570,000	50	112	120
Madison Gas & Elec. Co. " 1st Mtg. 6's	350,000	1,000	107½	108¼
" 6 per cent. scrip, due 1919	100,000	25	25	87
Montreal, Canada	2,000,000	100	218	184¾
Newark, N. J., Con. Gas Co	6,000,000	..	56	58
Bonds, 6's	4,600,000	..	105	105¾
New Haven	1,000,000	25	300	325
Nashville Gas Lt. Co	1,000,000	100	110	..
Oakland, Cal	2,000,000	..	46	47
" Bonds	750,000	..	..	..
Peoples G. L. & Coke Co., of Chicago	25,000,000	100	100¼	100¼
Peoples Gas Lt. & Coke Co., Chicago, 1st Mortgage	20,100,000	1,000	..	..
2d "	2,500,000	1,000	104	
Rochester Gas & Elec. Co..	2,150,000	50	88	.
Preferred	2,150,000	50	118	..
Consolidated 5's	2,000,000	..	87¼	90
San Francisco, Cal	10,000,000	100	41½	42¼
St. Paul Gas Light Co	1,500,000	100	45	47
1st Mortgage 6's	650,000	1,000	113	116
Extension, 6's	600,000	1,000	112¼	115
General Mortgage, 5's	2,465,000	1,000	92	93
St. Joseph Gas Co. " 1st Mtg. 5's	751,000	1,000	95	96½
Syracuse, N. Y.	1,975,000	100	29	..
Bonds	2,047,000	1,000	99½	100
Washington, D. C	2,600,000	20	377½	378¾
First mortgage 6's	600,000	..	..	..
Western, Milwaukee. Bonds, 5's	4,000,000	..	109½	110
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OFFICE OF THE UNITED GAS IMPROVEMENT CO., N. W. CORNER BROAD AND ARCH STS., PHILADELPHIA, PA., Dec. 10, 1902.

The Directors have this day declared a quarterly dividend of 2 per cent. (one dollar per share), payable Jan. 15th, 1903, to stockholders of record at the close of business, Dec. 31, 1902. Checks will be mailed.

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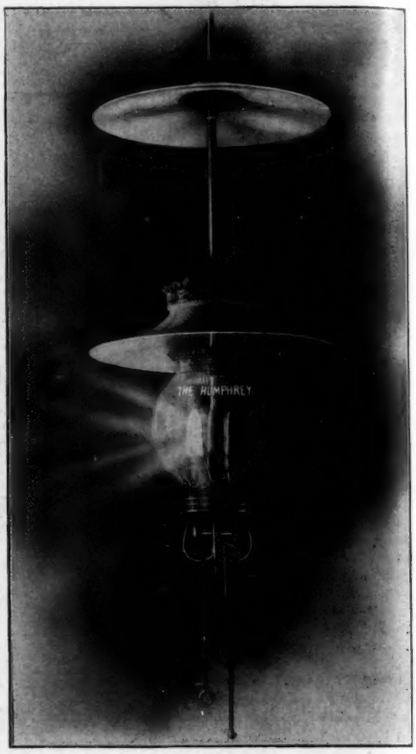

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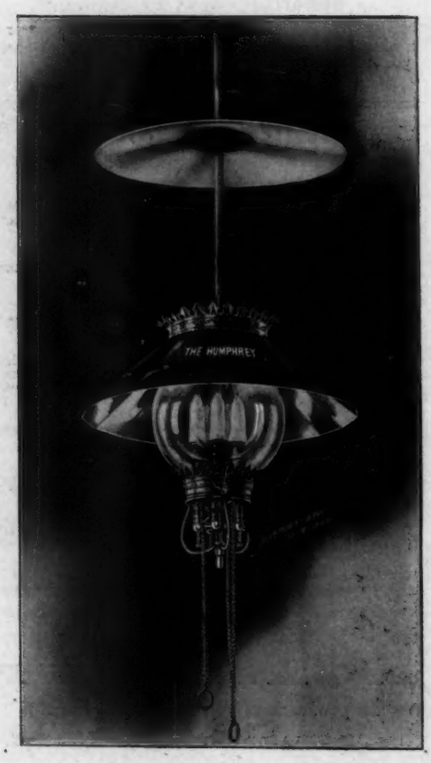

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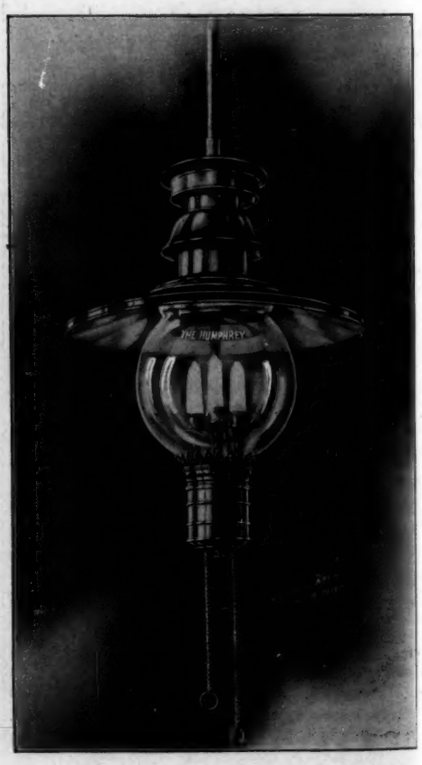

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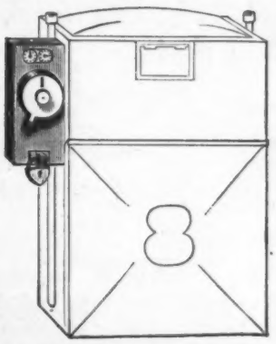

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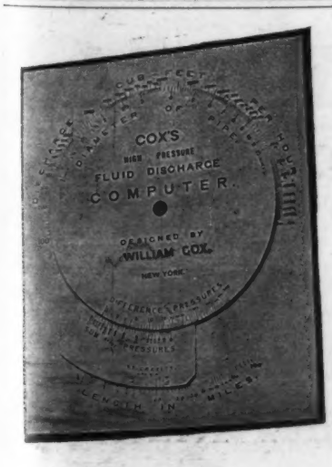

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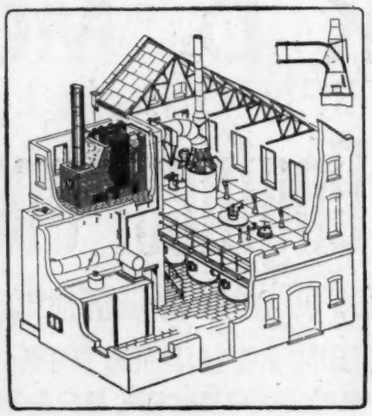

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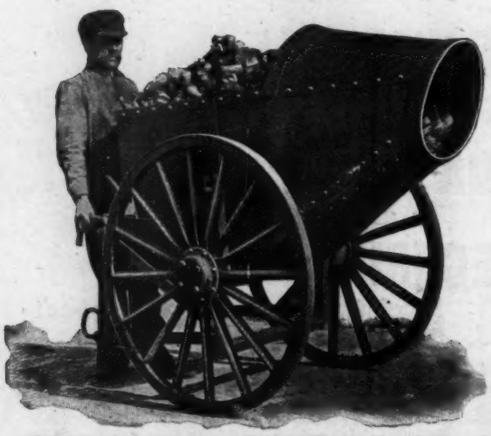

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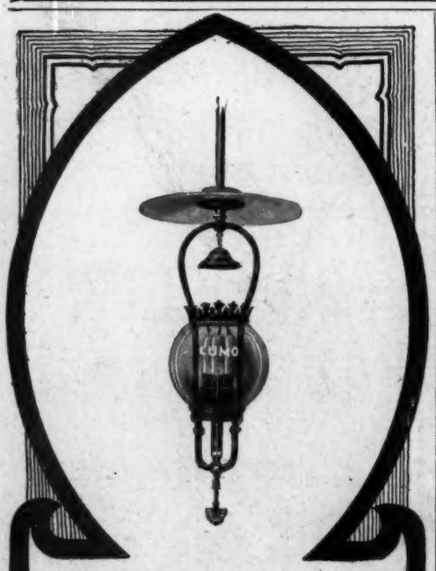

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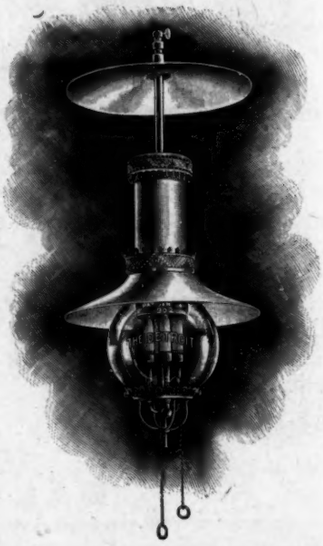

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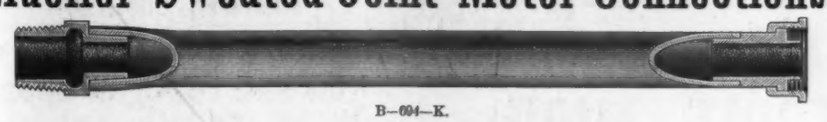

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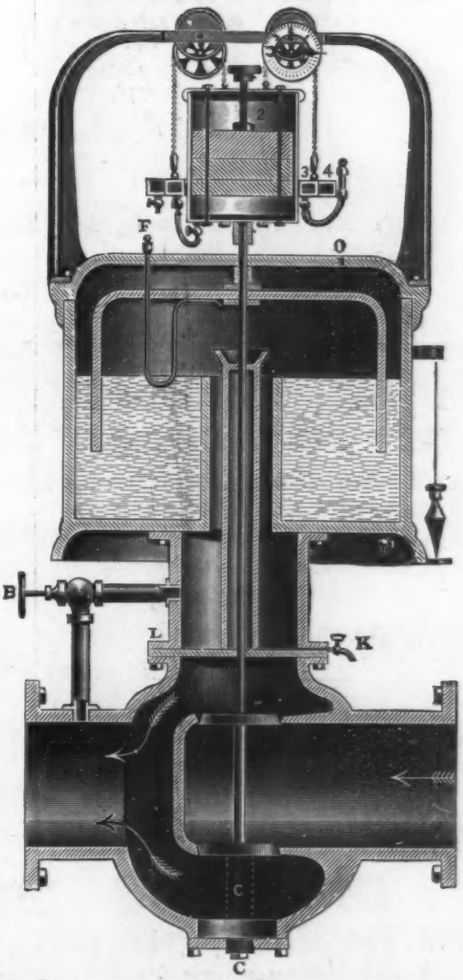

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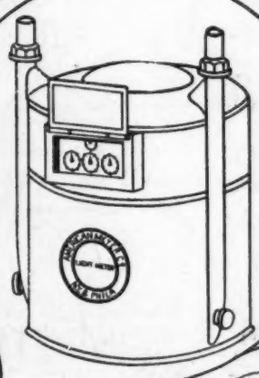

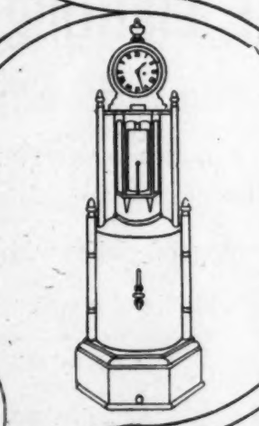

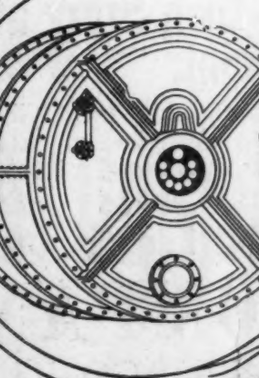

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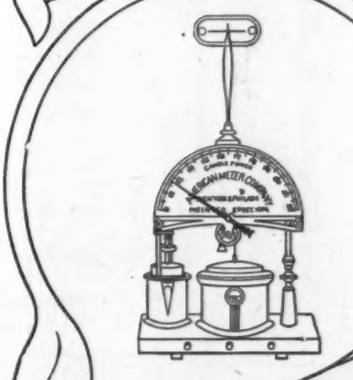
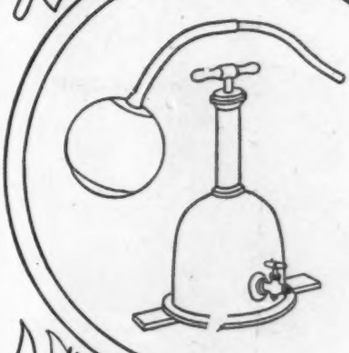
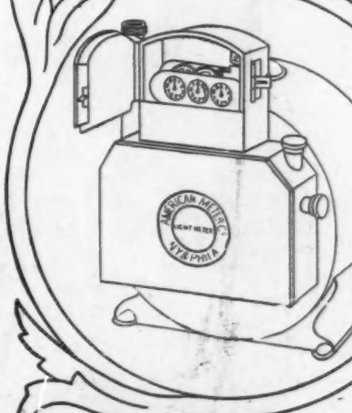
PUBLIC LIGHTING TABLE.

JANUARY, 1903.

Day of Week.	Date.	Table No. 1. Following the Moon. Light.	Table No. 1. Following the Moon. Extinguish.	Table No. 2. New York City. All Night Lighting. Light.	Table No. 2. New York City. All Night Lighting. Extinguish.
				P.M.	A.M.
Thu.	1	5.10 PM	6.20 AM	4.30	6.30
Fri.	2	5.10	6.20	4.30	6.30
Sat.	3	8.30	6.20	4.30	6.30
Sun.	4	9.30	6.20	4.30	6.30
Mon.	5	10.30	6.20	4.30	6.30
Tue.	6	11.40 FQ	6.20	4.30	6.30
Wed.	7	12.40 AM	6.20	4.30	6.30
Thu.	8	1.50	6.20	4.40	6.30
Fri.	9	2.50	6.20	4.40	6.30
Sat.	10	4.00	6.20	4.40	6.30
Sun.	11	5.00	6.20	4.40	6.30
Mon.	12	No L.	No L.	4.40	6.30
Tue.	13	No L. PM	No L.	4.40	6.30
Wed.	14	No L.	No L.	4.40	6.30
Thu.	15	5.30 PM	8.50 PM	4.50	6.25
Fri.	16	5.30	10.00	4.50	6.25
Sat.	17	5.30	11.10	4.50	6.25
Sun.	18	5.30	12.10 AM	4.50	6.25
Mon.	19	5.30	1.10	4.50	6.25
Tue.	20	5.30 LQ	2.10	4.50	6.25
Wed.	21	5.30	3.10	4.50	6.25
Thu.	22	5.30	4.10	5.00	6.25
Fri.	23	5.30	5.00	5.00	6.25
Sat.	24	5.30	5.50	5.00	6.25
Sun.	25	5.40	6.10	5.00	6.25
Mon.	26	5.40	6.10	5.00	6.25
Tue.	27	5.40	6.10	5.00	6.25
Wed.	28	5.40 NM	6.10	5 00	6.25
Thu.	29	5.40	6.10	5.05	6.15
Fri.	30	5.40	6.10	5.05	6.15
Sat.	31	5.40	6.10	5.05	6 15







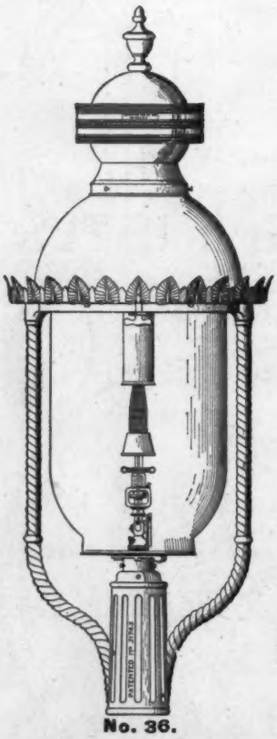
TOTAL HOURS LIGHTING DURING 1903.

By Table No. 1.	Hrs.Min.	By Table No. 2.	Hrs.Min.
January	245.00	January	423.20
February	192.00	February	355.25
March	201.00	March	355.35
April	167.20	April	298.50
May	152.00	May	264.50
June	131.00	June	234.25
July	140.40	July	243.45
August	156.20	August	280.25
September	171.20	September	321.15
October	198.20	October	374.30
November	216.30	November	401.40
December	232.10	December	433.45
Total, yr.	2203.40	Total, yr.	3987.45

NEW YORK, 33 Nassau Street. PHILADELPHIA, Broad and Arch Streets. CHICAGO, Foot of Orleans Street. BOSTON, 624 Tremont Building.
CLEVELAND, 809 Cuyahoga Building. ST. LOUIS, 712 Roe Building. SAN FRANCISCO, 712 Polk Street.

WELSBACH STREET LIGHTING COMPANY

.... OF AMERICA ....



No. 36.

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Which includes its specially DESIGNED AND PATENTED BURNER for STREET and PARK LIGHTING exclusively.

Uniformly SUCCESSFUL in 150 Cities and Towns.

By means of the Welsbach System of street lighting the superiority of GAS over electricity for street lighting has been fully demonstrated.

POINTS OF MERIT:

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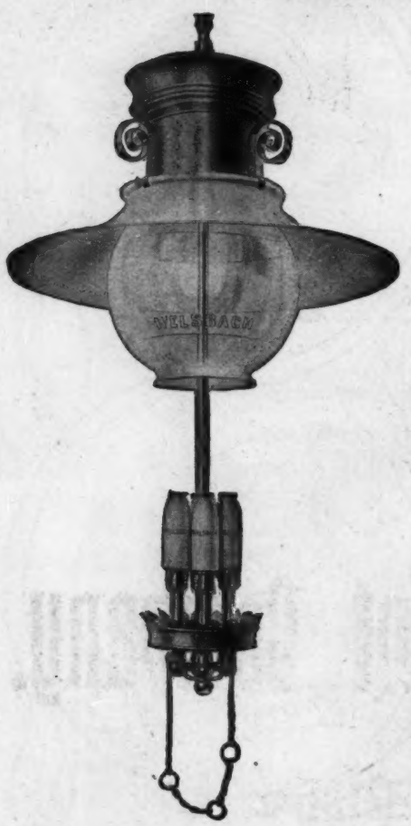
IT LIGHTS THE STREET.

Where there are no gas mains we can furnish an equally good light by our SELF-GENERATING NAPHTHA WELSBACH BURNER, and thereby supply a uniform light in all localities.

Correspondence Solicited from Gas Companies and Others Interested in Municipal and Outside Lighting.

No. 98.

The Welsbach Gas Arc for Indoor Lighting.



The cut tells the story—but not all of it. Get one lamp and light it—then the tale's told from beginning to end. For one Welsbach Gas Arc Lamp is a better salesman than 20 pages of advertising.

Here's what it would show if you give it a chance to prove its worth:

1. A mechanical construction and finish that insures the greatest durability.
2. The renewal of mantles and the cleaning of globes without removal of globe.
3. The greatest amount of candle power with least consumption of gas.
4. A by-pass cock so constructed as to permit all or only one mantle burning at a time.
5. A pilot light that consumes but 1 foot of gas in 24 hours. Costs $\frac{1}{10}$ of a cent a day.

Give it a Chance to Tell its Own Story and it Won't Disappoint.

Let us send you one lamp—doesn't cost a fortune—and it will answer every question you put to it; make good on every test given it. You know the only proof of the pudding? What's the use in a fellow telling you it tastes good? Taste it yourself, then you know.

May we Send you ONE Lamp?

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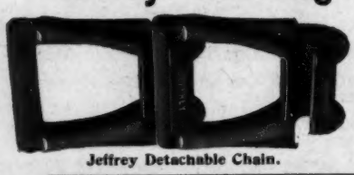

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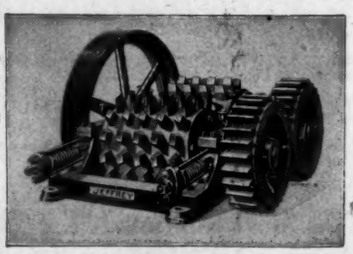

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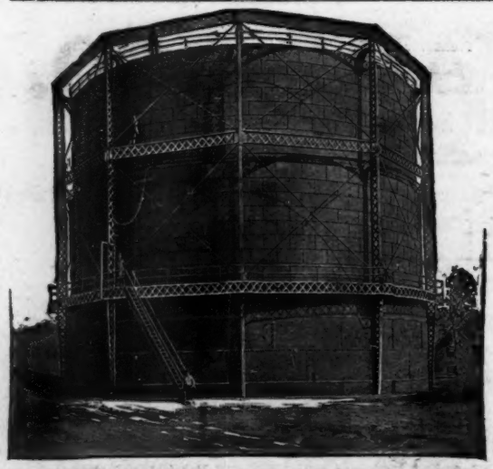

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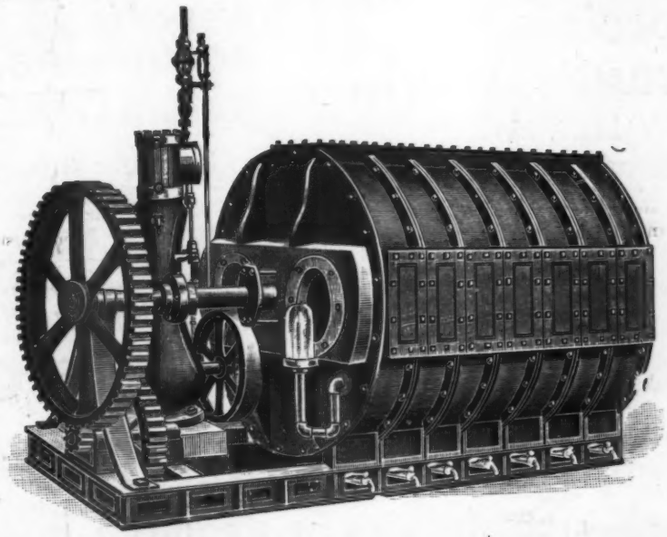

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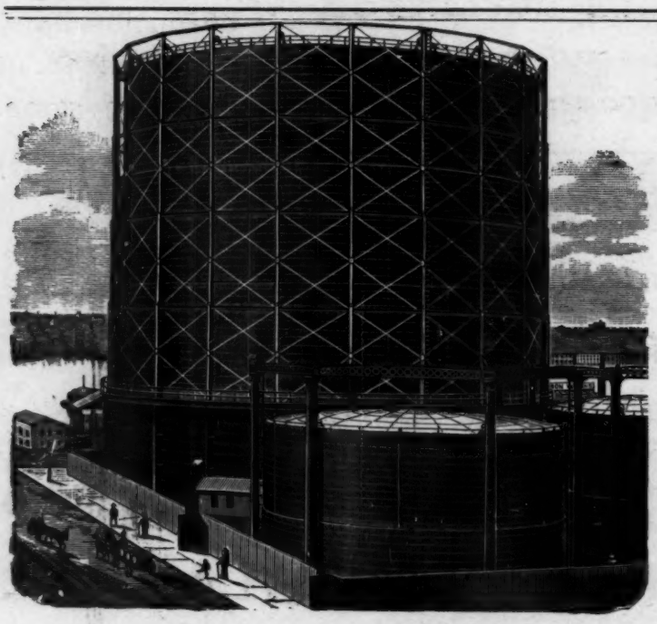

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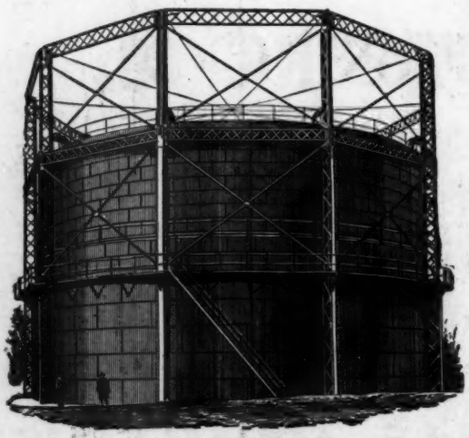

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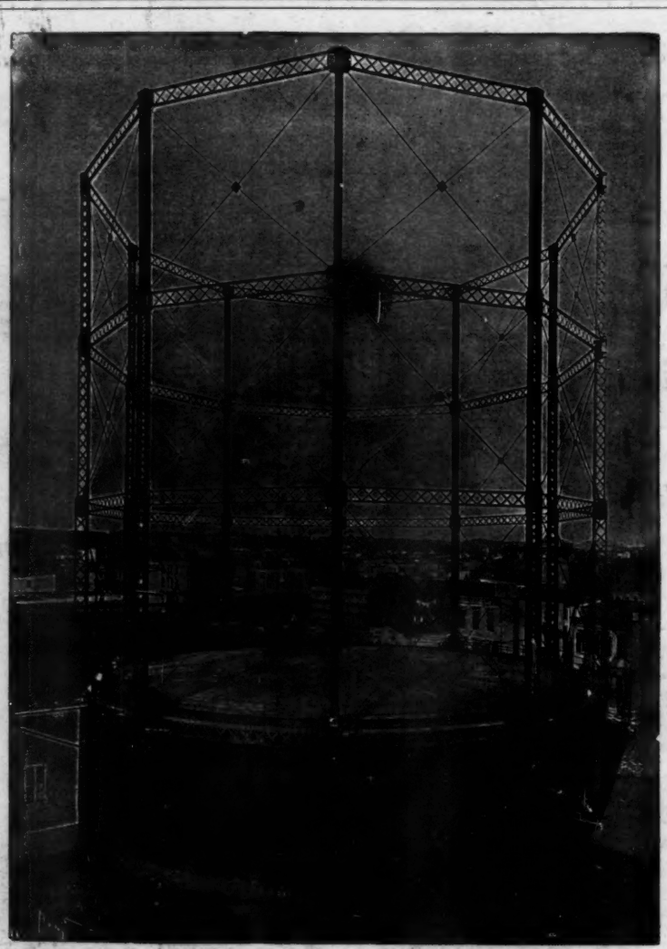

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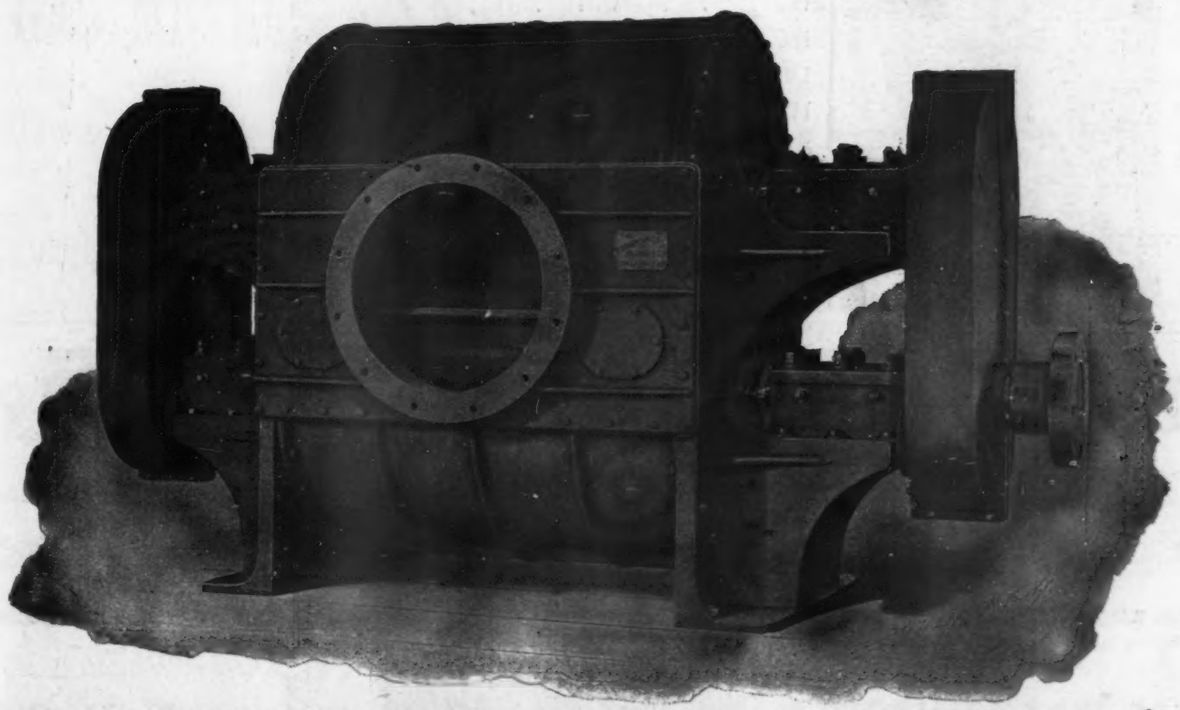

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